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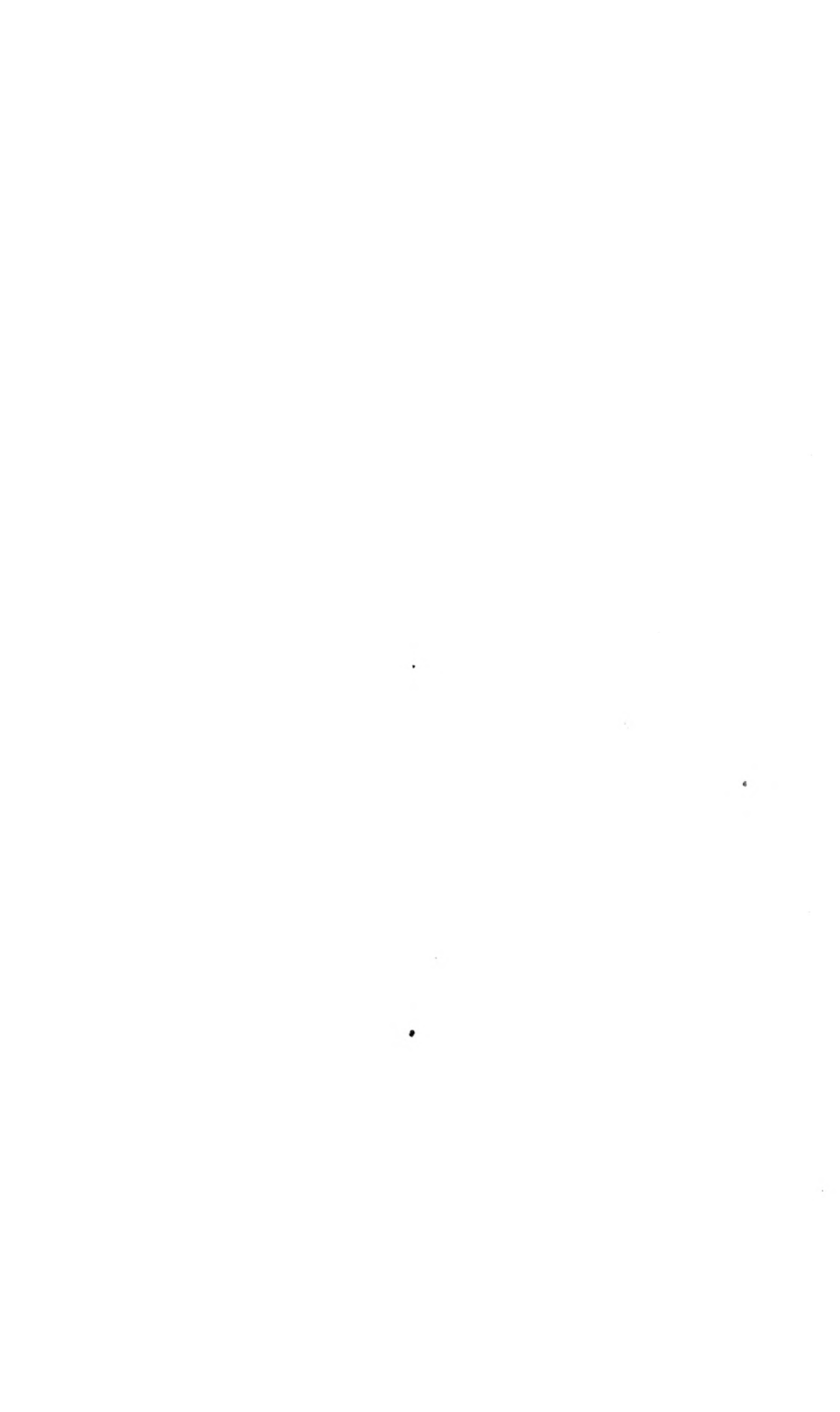
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ARCHIVES  
OF  
OTOLOGY

CANCELLED

EDITED IN ENGLISH AND GERMAN

BY

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## ARCHIVES OF OTOLOGY.

## ON THE CUPULA-FORMATIONS IN THE HUMAN LABYRINTH.

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IF after the publication of the researches of expert histologists on the so-called cupula-formations, and especially after the completion of Retzius' masterwork, I take up once more this theme, the undertaking may seem at least superfluous, and requires in a manner that I should state the reason for doing so. This I now beg to seek in the difficulty of the object, which has not thus far permitted a perfectly satisfactory solution of the questions relating thereto, and which induces me to hope that even minor contributions, aiming at the attainment of a better understanding, may not as yet appear entirely worthless.

By the aid of the celloidin method we succeed oftener now than formerly in fixing surprisingly beautiful sections of the cupula-formation upon the nerve epithelium of the membranous labyrinth. Based on more recent microscopic preparations made by means of this method, I believe that the formations upon the macula of the untricus and sacculus, known as covering membranes or cementing substances of the otoliths, should be interpreted in the same manner as the cupula terminalis of the ampullæ,—namely, as products of coagulation. This point especially seems to me to be in need of further elucidation, notwithstanding the admirable researches of the writers on this subject.

Before entering upon the consideration of these formations I shall briefly recapitulate, however, some of the data relating to the cupula of the ampullæ.

While the authors following Lang, who first found these formations in the labyrinth of the Cyprinoids, generally regarded it as a firm, laminated cuticular formation, Hensen, in the year 1872,<sup>1</sup> showed by investigations of the living gobius that the so-called auditory hairs in the ampulla were considerably longer than they were at that time assumed to be (contrary to the statement of Max Schultze), and furthermore endeavored to prove that the cupula terminalis was produced artificially by the swelling and matting together of the hairs as the result of the action of the nitric acid and alcohol, and finally that the striation of the cupula was merely due to the swollen and entangled hairs.

But as this view failed to receive the desired attention, and at that time was even contradicted by some writers, Hensen repeated his examination of the gobius, the sole, the eel, and the haddock, as well as on the *Rana esculenta*, and published a supplement to his remarks against the cupula terminalis (Lang<sup>2</sup>). In this supplement Hensen maintains his assertion that during life and in fresh preparations no cupula can be discovered, and that this is in consequence of the ability of the hairs to lay their ends alongside of one another; it could not be present even in an invisible state as a solid substance, and that it could be produced from the hairs by the action of nitric acid and alcohol as well as by osmic acid. At the same time it was stated, however, by Hensen, that the labyrinth should not be touched before the acid is applied, as otherwise no cupula would form, and he even arrives at the conclusion that a substance in a state of solution was present between and around the hairs, which contributed to the formation of the cupula and was even necessary thereto. The slightest touch will be sufficient to displace this substance. "One may assume that it is a substance similar to fibrinogen."

In a review, which I published in 1882, of the above-mentioned paper by Hensen, I wrote as follows: "If we should try to bring Hensen's views on the cupula in harmony with those of his opponents, it might perhaps be

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<sup>1</sup> *Arch. f. Anatomie u. Physiologie, Anatom. Abtheil.*, p. 486.

<sup>2</sup> The same *Arch.* for the year 1881, p. 405.

done in the following manner: a firm organized formation, to which the term *cupula terminalis* could be applied, does not exist during life; but later investigations by other writers have clearly shown that there is present upon the *cristæ* of the *ampullæ*, between the small hairs and in their vicinity a gelatinous substance which during life or in fresh preparations is transparent and cannot therefore be seen with the (low-power?) microscope. This substance, which is chemically different from the rest of the endolymph, coagulates when treated with nitric acid, chromic acid, osmic acid, or alcohol, and in combination with the small hairs furnishes the peculiar striated formation which Lang calls the *cupula terminalis*." And further: "The merits of having refuted the assumption of an organized firm cupula would thus not be taken from the author, and to his opponents might be conceded that the glueing together of the so-called hairs in the *ampullæ*, which in man do not by any means attain the same length as in the fishes and *amphibia*, does not constitute the only and essential factor in the formation of the cupula, and that on the other hand this term might well be retained for this, from a physiological point of view, certainly important substance."

This view, as the quotations given below will show, is now also shared by Retzius<sup>1</sup> and Hasse. It now only remains for me to rectify the passage referring to the length of the auditory hairs in the human *ampullæ*, in the above-mentioned remark, as my recent preparations of cupula from the human labyrinth have made it to me also more probable that the hairs reach up to the summit of the cupula-formation. The gelatinous or semi-fluid substance probably contracts during its coagulation, and thus the coagulated mass appears lifted off from the nerve-epithelium, and only a few broken short hairs are preserved upon

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<sup>1</sup> On page 364 of his great work Retzius, in speaking of Hensen's investigations with reference to the assertion that a substance in solution is present between and around the hairs, says: With this, in my opinion, Hensen has after all assumed the existence of a kind of cupula, a fluid cupula; although this cupula is something entirely different from the cupula described by Lang, Hasse, myself, Kuhn, and P. Meyer. Finally the passage in which Retzius gathers together his views on the cupula question is quoted literally in Moos' review of Retzius' work in these ARCHIVES, vol. xiv., page 298, fourth line from the top, to which the reader is referred.

the epithelial cells. One may thus easily mistake these remnants for the true representation of the hairs. Occasionally it is possible, however, to trace a connection between a few of the hairs visible in the empty interstices and the striæ in the cupula, especially in preparations in which the latter is found but a short distance from the epithelium.

But as the statements as to the length of the hairs have heretofore mostly referred to the ampullæ of the lower vertebrates, it has seemed to me to be of the greatest interest to compare the latest measurements, given by Retzius in his description of the human labyrinth, with those made by myself. It is stated on page 342 of Retzius' work that the length of the hairs on the cells of the maculæ in the sacculæ of the human labyrinth is from 0.02 to 0.025 *mm*, while the hairs on the cristæ are longer and sometimes measure as much as 0.028 *mm*. This difference is of course very insignificant, but Retzius adds that in all probability the hairs on the cells of the cristæ, in an un mutilated condition, are longer. With the latter statement we agree, and assume that the above statement, as to the length being 0.028 *mm*, refers only to the before-mentioned remnants of auditory hairs, exclusive of the cupula-formation. For on the supposition that the height of the cupula corresponds to the length of the hairs, since the fine striation can be traced to the summit of the cupula, a much larger measurement is obtained. In the sections of the human ampullæ measured by myself, the distance from the middle of the crista-epithelium to the roof of the ampulla was 1.36 *mm*, and the height of the cupula measured in the same line was 0.8 to 0.9 *mm*—therefore two thirds of the ampullar space. If to this we add the effects of the shrinking of the fluid cupula, whereby the auditory hairs are bent over somewhat at their ends, the length of the hairs in the living man can be estimated certainly at 1 *mm*.

Furthermore, I must recur to a statement by Hasse, which occurs incidentally in a review of Retzius' great work, in the *Arch. für Ohrenheilkunde* (vol. xxi., page 317, eleventh line from the top). Hasse makes known there his

inclination to side with Retzius and Hensen as regards the cupula-formation, and then continues :

" But one doubt I beg to mention. Out of the auditory hairs alone, even if they are swollen, the mass of the membrana tectoria cannot be formed : it is too large for that. It is therefore necessary to call to our aid a coagulating intermediate substance. But if we assume the presence of such a substance, it is remarkable that it is present nowhere else in the endolymphatic space, and that at no other place than at the cristæ acusticæ a coagulation of the endolymph occurs."

With regard to the concluding sentence, that coagulations of this kind within the endolymphatic space are not found at other places, the question may be asked : Are not the so-called membranes of the otoliths in the sacculæ, the soft, almost mucous layer which holds the otoliths together (Henle), the tenacious gelatinous substance (Rüdinger), the mass resembling the vitreous tumor (Max Schultze), products of coagulation similar to the cupula ampullæ, since the nerve-epithelium of the maculæ and cristæ, which is said to furnish these excretions, is in its structure almost alike ?

This question will be found justifiable if the accounts given by some of the most competent authors of the substance which unites the otoliths with the maculæ are placed together.

In Retzius' work, in the chapter relating to the human labyrinth (vol. ii., p. 342), we find : " Upon the maculæ acusticæ rests, as is well known, the very thin membrane of the otoliths, on the surface of which lie in a single layer the numerous smaller crystals, measuring from 0.001 to 0.015 mm." <sup>1</sup>

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<sup>1</sup> In other mammals Retzius describes this structureless membrane as of a gelatinous, mucous character. In the fishes are described homogeneous membranæ tectoriæ, with holes on the under surface, and also glassy homogeneous masses. The membranes show on microscopic examination often a fine striation ; compare among others the description of the pike. The author concludes his description of this fish as follows : " But the closer relation of this membranous formation to the macula acustica is very difficult to ascertain, as they are so easily separated from each other. Whether its auditory hairs really enter the holes of the membrane I am unable to determine with certainty, although it seems very probable." In the amphibians we again find the membranæ tectoriæ

Hasse found in the vertebrates, with the exception of the fishes, a closed otolith-sac-membrane,<sup>1</sup> which is formed out of a cuticular mass secreted by the nerve-epithelium and the cells in its vicinity. The otoliths crystallize out of it. The sac-membrane is thickest at the surface facing the epithelium of the macula, and here its structure is like that of the membrana tectoria, or the cupula terminalis of the ampullæ. At its lower surface it is more resistant, and exhibits bell-shaped empty spaces for the reception of the separate auditory hairs. In turtles Hasse saw a striation of the membrane, and in birds a reticular delineation. "The only difference between the covering membrane of the neuroepithelia in the recessus utriculi and on the auditory ledges (*i. e.*, cristæ) consists therefore in this: that in the former crystals of lime are formed in the interior of this cuticular mass, while in the latter the cuticular mass persists as a homogeneous membrane."

Kolliker describes in the sacculus a chalky-white and sharply bounded spot, visible to the naked eye, which is fastened to the inner wall by an entirely transparent, although 0.01''' thick, membrane, perhaps of an epithelial character.<sup>2</sup>

P. Meyer found in the utriculus of serpents, between the mass of otoliths and the nerve-epithelium, a fibrous, cuticular layer, in which are many holes and clefts; the auditory hairs project into this layer. In the sacculus the crystals of otoliths are held together by an amorphous, mucoid substance.<sup>3</sup>

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upon the maculæ described as thin, glassy, and transparent, striated at the margin, and containing in some parts empty spaces like vacuoles. In the chapter on reptiles we find described an irregular, striated-trabicular substance uniting the disk of otoliths with the macules in the utriculus of the *Lacerta viridis*. In the sacculus of the Alligator Mississip. a covering membrane could not be found by the author. In birds Retzius speaks of "thin covering membranes carrying crystals of otoliths," and describes such a one from the sacculus of the *Columba domestica*, as an extremely delicate, profusely ramified network. The accompanying illustration (fig. 1 on plate xvii.) corresponds almost exactly to the striated formation of the human sacculus, which I shall describe further on.

<sup>1</sup> Anatomische Studien, pp. 220, 278, 464. Supplement to the Anatomischen Studien, p. 80.

<sup>2</sup> "Gewebelehre," 1855, p. 663.

<sup>3</sup> Cited by Retzius. See his "Auditory Organ of the Vertebrates," vol. ii., p. 39.



Kuhn<sup>1</sup> was unable to find upon the macula of the utriculus in the labyrinth of the Chelonians the cuticular mass into which the fine hairs project, described by other authors. He found, however, in the sacculus an uncommonly thin-walled membrane, which enveloped the otolith, and observed in addition, especially in osmium-preparations, on the surface of the macula still another structureless covering mass, which had become hard and yellow through the action of the osmic acid, and in which were innumerable smaller and larger empty spaces. He adds, however, that this mass was absolutely invisible in fresh preparations alongside of the compact, milky-white pulp of the otoliths, and that in cross-sections of hardened objects it never remained in connection with the macula and the otoliths.

Of great significance is, furthermore, Hensen's statement concerning the relations of the otoliths in the fresh sacculus of the gobius.<sup>2</sup> It read as follows: "It (the great otolith) lies, supported by the hairs, only 0.01 *mm* distant from the surface of the epithelium, and its relations are such as I have depicted in Fig. 24 in my 'Physiology of the Organ of Hearing,' only the larger stones exhibit no longer an envelope. The cupula-like formations upon the macula acustica described by the author cannot be found."

From the above quotations it will be seen that the majority of the investigators named have found in both of the sacculi of the labyrinth of the vertebrates, between the mass of otoliths and the nerve-epithelium, a more or less soft, unorganized, and, according to Retzius and Hasse, often striated mass into which the auditory hairs projected,—a substance which Hasse formerly identified with the cupulæ of the ampullæ.

Now, if Hensen did not see these cupula-like formations in fresh preparations of the sacculus of the gobius; if Retzius missed the same in the sacculus of the alligator, and Kuhn in the utriculus of the Chelonians, and if the last-named author furthermore assures us that the mass in question is absolutely invisible in fresh preparations of the

<sup>1</sup> Ueber das häutige Labyrinth der Reptilien, pp. 313, 321.

<sup>2</sup> *Arch. f. Anatomie und Physiologie*, Jahrgang 1878, p. 406.

sacculus of the turtle, and becomes visible only after hardening in osmic acid, then the question, in my opinion, is exactly the same as that with regard to the cupula of the cristæ of the ampullæ—that is, the probability increases, that also the auditory hairs of the macula of living vertebrated animals are surrounded by a clear, transparent, semi-fluid, and, in a fresh condition, invisible substance upon and within which the otolith crystals lie,—a substance which, without, perhaps, possessing an enveloping membrane, is differentiated from the endolymphatic fluid only by a greater degree of concentration, and which, after the death of the animal, congeals either spontaneously or through the action of various reagents, into a soft, firm, unorganized mass, enclosing the auditory hairs, and whose striation is here also caused by the entangled hairs.

A support to this view was furnished by some of my own preparations of the human labyrinth. A distinct striation in the mass enveloping the otolith crystals of the utriculus and sacculus, I had already observed in previously made sections, and was reminded by it of the striation of the cupulæ of the ampullæ, from which it differed, however, in the greater breadth of the striæ. In my latest preparations, in which these formations were well fixed by celloidin, I was able to trace distinctly the passage of the hairs into the striæ. The greater breadth of the latter appears to me to be due to the fact that the hairs are here less thickly set than on the cristæ of the ampullæ. In the cupula of the ampullæ the hairs which cause the appearance of striation lie, as is well known, close together, while in the cupula of the sacculi there exists between each two hairs a measurable interval up to 0.007 *mm* in width, which is filled with the coagulated mass. The whole mass differs furthermore from the cupula of the ampullæ in this, that, corresponding to the shorter hairs, it is much lower, and in the preparation it is still lower, as the hairs which at first ascend in a vertical direction, already in the second third of their length bend over and continue thus bent in parallel arched lines for some distance, whereas, on the surface of the structure, on which the otoconia rests,

they end in almost a horizontal direction, thus producing the impression that they are pressed down by the weight of the otolith conglomeratæ. An exact measure of their length can therefore hardly be given. I found them approximately from 0.06 to 0.087 *mm* in length, scarcely one tenth the length of the hairs of the ampullæ. The preparations were stained according to Weigert's method with hæmatoxylin and potassium ferrocyanide, which left the lower portion of the coagulated mass surrounding the source of the hairs clear and transparent, while the upper portion has assumed a yellowish-brown tint. In some of the preparations the hairs cross one another in various directions, whereby net-like figures are produced, the meshes of which, in certain adjustments, might also be interpreted as holes or vacuoles. This appeared to me to be especially the case in sections which were more than  $\frac{1}{20}$  *mm* thick.<sup>1</sup> The question as to the nature and consistency of the intermediate substance is of course not alone of interest from a histological point of view, but is also of greatest importance for the solution of physiological problems, and may even deserve consideration for practical reasons. As otologists, we are naturally chiefly interested in the relations of the substance surrounding the auditory hairs in man during life. At present we are still waiting for a decision upon the question

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<sup>1</sup> The otoliths, which are of the size stated by Retzius, lie free on the surface of the cupula, but in my preparations there are several layers of these instead of a single layer. The otoliths are oblong hexagonal bodies, with an oval-shaped, lighter, almost transparent portion in the centre, which gives to the smaller of these bodies an appearance of rings in certain adjustments. A distinctly crystalline form cannot be recognized, as is well known, even under higher powers. In the preparations recently made by me I was surprised to find numerous small heaps of otoliths upon the pavement-epithelium of the utriculus and the sacculus. The simplest explanation of this would be, of course, that the otoliths became detached from the cupula and were washed here. But as only the smallest, hardly measurable, forms were found here, the thought might also occur that they took their origin not only from the region of the nerve-epithelium, but that the elements of the pavement-epithelium of the sacculi might also produce them. In this connection I beg to draw attention to the peculiar condition of the pavement-epithelium of the endolymphatic spaces described by me in *These ARCHIVES*, vol. x., p. 145. The assumption that the otoliths crystallize out of the cupula of the maculæ is likewise hypothetical, and is connected with the supposition that the otolith-sac-membranes are closed. Rüdinger observed otoliths also in the semicircular canals of man and birds, whose vestibule was uninjured. He expresses no opinion as to the origin of the bodies in question, but says that he does not believe that they were carried there from the utriculus.

whether the otoliths serve as mechanical resistencies of the nervous apparatus, or whether they, in conjunction with the intermediate membranes, have the functions of a protecting and damping apparatus. The first view presupposes a certain inertness and insensibility of the terminal apparatus of the auditory nerve, while the latter presumes an opposite state, a very easy excitability. In my opinion, the solution of these enigmas has been made more difficult rather than easier by the otherwise meritorious studies of the organs of the invertebrates, for the tradition that the otoliths act as tetanometers, which is found in all the textbooks on physiology, has not been beneficial to the advancement of our understanding of the physiological procedures in the function of hearing of the higher vertebrates. While Helmholtz<sup>1</sup> finds the otoliths to be in a high degree adapted for exerting a mechanical irritation on the nervous mass with every sudden motion of the water of the labyrinth, Hensen<sup>2</sup> admits that the structure of the otolith-apparatus and the semicircular canals of the higher animals has as yet furnished no special support to the physiological view.

The function of the large compact otolith of the osseous fishes can only with difficulty be brought in harmony with that of the tiny crystals resting on a glassy mass, and it was perhaps merely for reasons of appropriateness that a greater solidity was claimed for the cupula-formations which unite the otoconia with the maculæ of the sacculi. It was assumed that the auditory hairs projecting into the bell-shaped hollow spaces of this membrane were excited by the movements of the covering membrane. The latter was regarded as functionally equivalent to the compact otoliths of the fishes. Now with regard to the great otoliths of the osseous fishes, especially of the pike, I beg to direct attention to a description given by Max Schultze, in his paper on the mode of termination of the auditory nerve in the labyrinth,<sup>3</sup> which, it seems to me, has received but little attention. The author points out the firm immovable

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<sup>1</sup> *Lehre von der Tonempfindungen*, p. 287. <sup>2</sup> *Physiologie der Gehörs*, p. 102.

<sup>3</sup> *J. Müller's Arch. f. Anatomie und Physiologie*, Jahrgang 1858, p. 367.

position of the otolith in the sacculus of the pike, produced by the exact adjustment of the stone to the wall of the sacculus in the vicinity of the macula. For the reception of the macula itself, the otolith possesses however a furrow, which is, however, so deep that it is not entirely filled by the crista. Contact with the nerve-epithelium is thus excluded, and the more so since Schultze was unable to find auditory hairs in the pike. A direct transmission of the oscillations of the otolith to the nerve terminations for the production of a mechanical tetanus in the acoustic nerve is therefore desired, but the possibility is pointed out that under the resonating influence of the otolith, undulations of the fluid may be produced which tetanize the nerve. If I rightly understand the description, the otolith is in this instance to be conceived rather as a covering and protecting apparatus, and there would also be no need for us to place, without further ceremony, the compact otolith of the fishes on the same level with the mobile concrements in the auditory vesicle of the invertebrates. It would be conceivable too that the excitability of the nerves of spinal sense in the animal order increases from below upward, and that the lower animals require strong irritants there when more highly organized creatures are in need of a damping apparatus. Now with regard to the agglomerations of otoliths, Waldeyer<sup>1</sup> is of the opinion that these formations, which remind him of a sandbag are not adapted for being thrown into regular oscillations, but that, on the contrary, they must possess the capacity to dampen the oscillations of other bodies with which they come in contact. This opinion is shared by Landowsky,<sup>2</sup> who regards the otoliths as mechanical dampers. Finally Hasse<sup>3</sup> occupies a middle position, and till lately believed that the cupula terminalis, into whose bell-shaped hollow spaces the auditory hairs project, communicated to the latter the motions of the endolymph, and that essentially the same occurred in the utricle and sacculus. According to Hasse, these cuticular membranes

<sup>1</sup> Stricker's "Gewebelehre," Bd. ii., p. 952.

<sup>2</sup> Untersuchungen über den akustischen Endapparat der Säugethiere, *Arch. f. mikroskopische Anatomie*, Bd. xiii., p. 544.

<sup>3</sup> Supplement zu den anatomischen Studien, pp. 68, 78, and 81.

have, moreover, at the same time the function of a protecting apparatus against other movements of the endolymph than those caused by sound waves.

*Now, if we regard a mechanical commotion of the auditory hairs through the motion of the endolymph an adequate irritation for the terminations of the auditory nerve in the ampullæ and sacculi, and if furthermore it should be established that the auditory hairs in the ampullæ as well as in the sacculi during life are enveloped by a tenacious fluid of greater consistency than the endolymph, then there can be no doubt that this substance restricts the vibrations of the auditory hairs and thus acts as a protecting apparatus and damper.* The aggregates of small otolith crystals can at most increase the loading of the hair.

Under the presumption of a gelatinous mass in the region of the cristæ and the maculæ, the question finally attains also practical interest. It will be permissible to conclude that the peripheric excitability of the vestibular nerve must rise or fall the instant the slightest fluctuation occurs in the consistency of the substance enveloping the hairs. It is self-evident that with reference to this point we can entertain only conjectures so long as the function of the nerve-epithelium of the sacculi is shrouded in darkness, and the exact chemical composition of the endolymphatic fluids and the cupula-substances remains unknown. Changes in the consistency of the endolymphatic fluids and in the cupula substances one might expect just as well in chronic passive hyperæmia of the labyrinth as in a hydræmic condition of the blood, following profuse loss of blood and other humors, as, for instance, after childbirth and in leucæmic conditions, and thereby again explain many of Ménière's symptoms dependent on increased irritability of the vestibular nerve, without having constantly recourse to hemorrhages in the labyrinth, to anatomical lesions of the same, or to changes in the central nervous system. An increase in the intracranial pressure, propagation of the same to the perilymphatic fluid, and changes in the relations of the diffusion of the endo- and peri-lymph might here also come into question. The good results obtained in a few

cases of chronic affections of the labyrinth from injections of pilocarpine and courses of cathartics<sup>1</sup>—purely empirical procedures having for their object the elimination of large quantities of fluids from the body—may perhaps also be explained on this line, for a resorption of the organized products of inflammation as the result of these procedures will not be expected by any one. On the other hand, the good effect of tonic treatment on subjective noises in the ears, vertigo, and syncope might also be explained with the aid of the above theory.

But be this as it may, I hope to have shown by this communication that the question as to the cupula-formations requires renewed investigations and labor on the part of experts in histology and physiology. May the allusion to the practical therapeutical interest of the question be an incentive to such work.

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<sup>1</sup> See Case 6, Jacobson's contribution from Lucae's clinic, *Arch. f. Ohrenheilk.*, Bd. xxi., p. 287.

# REPORT OF A POST-MORTEM EXAMINATION OF THE AUDITORY ORGANS OF A PATIENT WHO DIED OF CEREBRO-SPINAL MENINGITIS.

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(A communication from the Patho-Anatomical Institute at Giessen.)

Translated by DR. JEFFERSON BETTMAN, N. Y.

A. H., a laborer, aged twenty, died of cerebro-spinal meningitis in the hospital at Giessen May 31, 1885. At the time of his admission, May 23d, the patient was already in a comatose state, and his amount of hearing power accordingly could not be determined. Two days prior to his death consciousness partly returned, and the patient appeared to understand questions put to him in a loud voice. This, however, was merely temporary; he soon lapsed into a somnolent state and continued so up to his death. Upon post-mortem examination, the left auditory nerve was found embedded in a yellow creamy exudation. As an involvement of the structure of the labyrinth appeared probable, a detailed examination of the latter, even though no functional examination had been made, was desirable. The main points in the clinical history<sup>1</sup> are as follows:

The patient claims to have been perfectly healthy and able to work up to the evening of May 22d. The following day he complained of great lassitude and malaise and remained in bed. These symptoms increased towards evening, and the patient was brought to the clinic. At time of admission examination showed

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<sup>1</sup> The author is indebted to Professors RIEGEL and BOSTRÖM for the material upon which these investigations have been made, as well as for the clinical data and post-mortem report of the case.



him to be of medium size, well-built, much affected by his illness. Skin and face are pale, very hot to the touch. Eyelids are closed; the eye when opened presents a staring expression. The pupils, moderately dilated, react promptly. The tongue is not coated; cavity of mouth is dry. The patient responds to loud questions by merely opening his eyes. Increased carotid pulsations are felt over the neck. Percussion of the well-developed chest reveals no morbid changes in the lungs; on auscultation vesicular breathing is heard everywhere. The area of cardiac dulness is not increased; the apex impulse is distinctly visible and can be felt in the fifth intercostal space in the mammillary line. Abdomen is somewhat prominent, not tender to touch; liver and spleen are not enlarged. Passive movements call forth great tension of the extremities. The patient constantly touches his genitals. The evening temperature is  $40.8^{\circ}$ ; radial pulse is 60, of moderate tension and easily compressible. Number of respirations 32. Treatment consisted in applications of ice-bags and taking of wine; at night a hypodermic injection of morphia, 0.01, produced rest.

*May 24th.*—Increasing somnolence with loud cries. Tension in the back of the neck. Hyperæsthesia of the abdomen. Retention of urine necessitating catheterization.

Constipation, notwithstanding calomel had been given in dose 1.25. Profuse sweating. Morning temperature  $38.1^{\circ}$ , in the evening  $37.5^{\circ}$ ; pulse 88, 80.

*May 25th.*—Since yesterday evening increasing strabismus convergens of the right eye; distinct spasmodic flexion of the knees. Stiffness of neck exaggerated. The patient frequently utters loud cries in his sleep. Naso-labial herpes is beginning to develop. Marked injection of the left bulbar conjunctiva. Calomel and infusion of senna produced no evacuation of the bowels. The urine drawn with the catheter showed traces of albumen. Morning temperature,  $38.2^{\circ}$ ; evening,  $38.1^{\circ}$ . Pulse, 56; respirations, 84.

*May 26th.*—Marked vesicular herpes mentalis. The left conjunctival sac contains a small quantity of purulent secretion; slight abrasion or defect of the corneal epithelium. The fundus of the left eye is normal; the arteries in the right eye are slightly contracted; veins turgescient; the optic disc not well defined. Alvine and urinary dejections passed in bed. Morning temperature,  $38.5^{\circ}$ ; evening,  $38.1^{\circ}$ . Pulse, 68.

*May 27th.*—Slight epistaxis; some irritation of the right con-

junctiva. TROUSSEAU's phenomenon can be easily called forth over the entire surface of the skin. Comb-shaped retraction of the abdomen. *The head is constantly deflected toward the left side.* Morning temperature,  $38.9^{\circ}$ ; evening,  $38.2^{\circ}$ . Pulse, 72, 88.

*May 29th.*—Consciousness almost entirely returned during the morning. Superficial bed-sore at the sacrum. Temperature and pulse gradually increased ( $40.4^{\circ}$  and 136 in the evening of the 30th), and death set in the next morning without any unusual symptoms.

*Extract from the Report of the Autopsy.*

The spinal dura is tense. On dividing it, the arachnoid and pia on the posterior side of the cervical portion of the spinal cord are distinct and whitish in appearance. Veins are very turgid and tortuous. In the dorsal portion and increasing toward the lumbar portion of the spine, these membranes are discolored and purulently infiltrated. The cauda equina and the filamentum terminale are the parts mostly involved in this infiltration. The membranes covering the anterior surface of the cervical part of the spine are intensely injected; *markedly also the roots of the nerves.* This injection is not as marked in the dorsal portion, and the purulent infiltration is not as profuse in the anterior as in the posterior surface of the lumbar division of the spine. The cord upon section in the level of the second cervical vertebra is soft; the white substance vascular. Lower down to that portion corresponding to the third dorsal vertebra, this soft consistency increases, while the lumbar portion of the cord is much firmer. The calvarium is congested; the dura tensely stretched and vascular. The longitudinal sinus contains a firm blood-clot. The superior face of the soft membranes, more marked on the left side, is very hyperæmic, the veins injected to their terminal ramifications. Posteriorly slight œdema; in some parts a purulent infiltration. On both sides and in the fossæ Sylvii there is a purulent infiltration following the course of the veins. This same condition is noticeable at the base of the brain, more so on the left than on the right side, and in the region of the olfactory nerve. The trifacial, facial, and acoustic nerves appear to be imbedded in pus on the left side of the pons. The brain substance is soft in consistency and hyperæmic. A small abscess filled with greenish pus is found in the white matter of the left lobe. The tissue surrounding it is very much infiltrated and hemorrhagic. The left lobe is less injected.

The posterior cornua contain some purulent fluid. The ependyma of the lateral ventricles is congested.

*Macroscopic Condition of the Auditory Organs—Left Temporal Bone.*

Hyperæmia of the dura covering it. Small ecchymoses in the neighborhood of the aqueductus vestibuli. The dural pouch of the latter is empty. The sheath of the greater superficial petrosal nerve is very hyperæmic. The venous channels are empty. Only the inferior petrosal sinus contains a small clot of blood adhering to the lower wall. The ext. auditory meatus, the membrane and cavity of the tympanum do not take part in the inflammation. The Eustachian tube contains some mucus. The internal auditory meatus is filled with a cheesy exudation, which does not flow off but adheres firmly to the nerve. The entrance to the aqueduct of the cochlea is filled with the same exudation. This mass of exudation is a direct continuation of that extending from the cranial cavity and enclosing the nerves (9, 10, 11) passing through.

*Right Temporal Bone.*

The dura mater is less injected than on the left side. The endolymphatic sac is empty, its inner surface smooth and not congested. The neurilemma of the greater superior petrosal nerve is injected. Venous sinuses are empty. The bulbus of the jugular vein and the internal carotid artery contain small blood-clots. The external auditory meatus, drum membrane, and the tympanic cavity are normal. The Eustachian tube is patulous and contains no mucus. The neural sheath in the internal auditory meatus is grayish-red in color ; macroscopically presents no trace of any exudation. The aqueduct of the cochlea appears normal.

*Microscopic Examination.*

Both temporal bones were treated with a one-per-cent. solution of osmic acid, decalcified with a solution of chromic and hydrochloric acids, and then impregnated with celloidin. Beginning at the apex of the pyramid, the sections were made longitudinally to the long axis of the temporal bone. These sections were continued to the base, including in order the cochlea with the internal auditory meatus with its nerve, then the aqueduct of the cochlea, the vestibule, and last of all the semicircular canals. In studying the specimens the object was to get as comprehensive a view as possible of each section of the pyramid. The osseus nuclei remaining

after decalcifying the bones were prepared for section by periodic immersions in a twenty-per-cent. solution of hydrochloric acid and diluted alcohol. Celloidin as an embedding mass protects the labyrinthine structures from the corrosive action of the acid.

### *Left Labyrinth.*

*Inner auditory meatus:* The vessels of the dura mater are markedly injected. The arachnoidal sheath of the nerves is detached from them and the dura; between it and the trunks of the nerves, also between the nerve fibres, are aggregations of numberless cells. *The facial nerve is affected in a manner similar to the acoustic.* The blood-vessels in all parts, especially those between the bundles of nerve fibres, are intensely injected. At some places extravasations of red blood corpuscles, staining the tissue surrounding the vessels, have taken place. These cells, in the main, have the shape and appearance of ordinary pus corpuscles. Other cells, somewhat larger, measuring on the average 7-24 mikrom. in diameter, containing darkly-stained (osmium), coarsely-granular protoplasm, besides less numerous round hyaline cells of varying size, with highly refracting contours and nuclei irregularly placed, in some near the periphery, in others apparently placed like an excrescence outside of the cell-wall, giving it the appearance of a seal ring, were also noticeable. For brevity's sake these last-mentioned cells will hereafter be alluded to as "ring-cells." *The nerve fibres present no visible changes.*

*Aqueduct of the cochlea:* In all the transverse sections this structure appears filled with cellular masses. Fortunately two sections of the long diameter of that portion opening into the scala tympani were obtained. In both of these the entrance of the pus into the cochlea was easily and clearly demonstrable. The beginning of the aqueduct was markedly dilated.

### *The Cochlea.*

*Scala tympani:* The largest infiltration of cells, similar in appearance to those found in the internal auditory meatus, is found in the neighborhood of the opening of the aqueduct of the cochlea. They fill the entire structure, extending to the membrane of the round window, which bulges outward. Smaller aggregations of cells are visible here and there along the margin of the tympanic portion of the spiral ligament. In some sections a hemorrhagic extravasation from the blood-vessels of the spiral ligament is

noticeable. Isolated cells are visible along the margin of the periosteal lining of the scala. At places this lining is raised and fibrillated, the blood-vessels passing between it and the bone being in part exposed. The contents of the vessels appear to be a homogeneous coagulum, no single corpuscles being discernible. The *scala vestibuli* is more or less filled with amorphous masses. They are composed of coagulated exudation, partly granular and in part flaky débris, and a few cellular structures. In a few specimens small cast-off osseous particles are also found.

The *osseous basilar membrane* and the nerves ramifying through it appear unchanged. This notwithstanding the changes affecting the periosteal lining.

*Ductus cochlearis* : In many of the sections the organ of Corti appeared passably preserved. The series of arches is intact. The inner cells of Corti, even the finer nerve fibres in the tunnel, are frequently recognizable. The outer cells of Corti are not well preserved, appearing small and shrunken. Both Corti's and Reissner's membranes are in the main well preserved. The ductus cochlearis does not contain any foreign cellular structures. The epithelial cells lining the ductus, principally those along the lower surface of Reissner's membrane and those of the stria vascularis, appear swollen, loosened, and in the process of detachment. This condition is most noticeable in the smaller confines of the third turn of the cochlea; the scala tympani of which, also demonstrating the above-mentioned aggregation of flaky débris, appears almost entirely choked up. The layers of tympanic epithelium of the membranous basilar membrane appear denser than normal.

*Spiral ligament* : The vessels in all parts very much injected, bloody extravasations within and along the margin of the ligament. Between the meshes and in the vicinity of the blood-vessels are accumulations of cells.

*Modiolus* : Numerous cells, similar to those in the internal auditory meatus, are visible in the vicinity of the bundle of nerve fibres penetrating the modiolus and in the confines of the first turn of the cochlea. Cells are also found in the open spaces in the bone, principally in the neighborhood of the blood-vessels. The vessels are very much injected and in parts surrounded by blood extravasations. No cells are visible between the ganglion cells in the canal of Rosenthal.

*Ramus vestibuli* : Sections through the lower ampullar branch,

the saccular branch, the utricular branch, and the two branches distributed to the two upper ampullæ and the osseous canals, show everywhere that the neurilemma of these nerves in the beginning of their course is infiltrated with pus cells, in their peripheric portions exclusively by the so-called "ring-cells."

Facial nerve: The spreading of the cell infiltration along this nerve from the internal auditory meatus can be traced almost to the ganglion geniculi. Beyond this point, the sheath of the nerve does not seem to be involved.

#### *Vestibule and Semi-circular Canals.*

Sections of the perilymphatic portion of the vestibule present heaping up of detritus mixed with cell structures, a condition similar to that described in the scala vestibuli of the cochlea. Isolated and groups of ring-cells are also noticeable. Excepting a loosening of the epithelia, the walls of the saccules present no marked changes. The nerve-epithelium of the maculæ, the cupulæ and otoliths of which are discernible, also show no changes. The epithelium which normally lines the ligamentous fibres appears to be wanting in places; the spaces thus formed are occupied by adhering ring-cells of varying size. These same shaped cells are very numerous between the nerve fibres and branches of vessels penetrating the maculæ. The ligamentous bands of the ampullæ present the same appearance. Here, also, the cupulæ were mainly preserved and the nerve epithelia of the cristæ and the nerve fibres distributed to them appeared unchanged. Marked destructive changes are visible in the same circular canals. These have most progressed in the upper and posterior canal, while the horizontal canal only represents the beginning or earlier period of the morbid process. Cross-sections of the membranous canal of the latter show it to be normally adherent, the basilar membrane including the papillæ presenting no morbid change. The exterior layer, however, is slightly raised and portions of its lumen filled with cellular detritus. *The periosteal lining of the bony canal is raised in layers by the exudation, the smaller blood-vessels are in part injected, the tissue surrounding them hemorrhagically infiltrated, and in part filled with a yellowish coagulum.* The bony canal, furthermore, contains the same flaky débris, remnants of tissue and ring-cells, as found in the scala vestibuli. These are heaped up along the periosteum projecting into the lumen of the canals, leaving only the centre free. In localized portions of the posterior and upper canals,

and their common outlet, the periosteum is completely stripped off, the bone underlying denuded. The lumen of these canals is filled with a necrotic mass, consisting of coagulated exudation, particles of bone, remains of the fibrous tissue lining the bone, and *fragments of the small, clogged-up periosteal blood-vessels. In many sections no trace of the membranous canal is visible.* In others, it was found *stripped off the bony wall and compressed* in the middle of the osseous canal. They presented varying differences the description of which would lead to a too detailed account. Sections extending generally through the long axis of the aqueduct of the vestibule, showed it to be uniformly dilated. Excepting the presence of some coagulated lymph and a few ring-cells, nothing abnormal was noticeable. The blood-vessels in the interior of the petrous portion of the temporal bone did not seem to be involved.

#### *Right Labyrinth.*

To prevent repetition, it can be stated that a condition similar to that existing in the left labyrinth, only in a more modified extent (excluding the condition of the posterior semicircular canal), is found to exist; possibly the destructive process may have begun here at a later period. The internal auditory meatus contains far less cells than that on the left side, and scarcely any are visible in the aqueduct of the cochlea. Correspondingly few pus corpuscles are noticeable in the modiolus and in the scala tympani. Ring-cells are, however, found everywhere, and the scala vestibuli contains the same structureless tissue *débris*, only in less quantity, as described on the left side. This mass extends into the perilymphatic spaces of the vestibule. Excluding the presence of ring-cells between the ligamentous bands, the saccules themselves present no abnormality. The vessels of the right labyrinth are much less injected than those on the left.

Contrary to this, the posterior semicircular canal presented the same destructive changes as that on the left side. The superior and horizontal canals, however, appeared to be in a more initial period of the morbid process, and exhibited changes similar to those detailed on the left side. The aqueduct of the vestibule was not satisfactorily defined. Both aqueducts appeared to be narrower.

#### REMARKS.

Although no proliferation of the nuclei of the blood-vessels (MERKEL) or thickening of the vascular tunics (HEL-

LER) were observed, the conditions described agree in many respects with the published observations of HELLER, LUCÆ, and MERKEL. I wish, however, to dwell on certain points which seem to me to have an important bearing on the course of the inflammatory process, and, moreover, relate to the actual origin of the destructive changes in the ear. There is little doubt that in this case the pus gained access from the cranial cavity through the left aqueduct of the cochlea, penetrated into the scala tympani of the cochlea, and travelled also along the first thick branch of the nervus cochleæ into the base of the modiolus. Perhaps the right side was exclusively affected in the last manner. In referring to the penetration of pus into the modiolus, we must however remark that this condition was only clearly demonstrated in the first turn of the cochlea. The finer the dividing branches of the cochlear nerve running toward the apex of the modiolus, the less space do their osseous canals offer for the penetration of cellular structures. The intact state of the ganglion cells in Rosenthal's canal, arranged so compactly one against the other, finally impress me as not favoring the passage of pus corpuscles. Assuming, in any case, that the pus gained access to the scalæ of the cochlea alone by way of the nerve, it necessarily had to pass through the layer of ganglia, penetrate through the fine canals of the lamina spiralis ossea, and finally through the perforations of the zona perforata to arrive in the ductus cochlearis. As no pus was found in the ductus cochlearis, in fact in none of the endolymphatic spaces, this in itself improbable occurrence may safely be excluded in the case under discussion. Contrarily, it can easily be seen that the passage of pus along the bundle of nerve fibres to the base of the modiolus will readily explain its penetration into the numerous spaces and fissures of the loose tissue of the modiolus, its presence in the perivascular spaces of the vessels, thus disseminating the inflammation. As part of the open spaces of the modiolus are separated from the scalæ of the cochlea only by a thin periosteal partition, it is possible that pus corpuscles may penetrate into the scalæ through the tissue meshes of this membrane.



Considering the *quantity* of pus entering from the cranial cavity, and its *rapid* dissemination in all the labyrinthian cavities by means of the perilymph, this manner of migration seems less probable than that by way of the aqueduct of the cochlea.

Irrespective of the pus penetrating from the cranial cavity, the formation of pus in the labyrinth may be looked upon as a product of an extension of the inflammation, *i. e.*, by diapedesis of white blood corpuscles and proliferation of the fixed connective-tissue cells. Further on we shall allude to this point, and merely state here that there was no indication of a marked increase of *genuine* pus cells,<sup>1</sup> and that the amount of pus found was out of proportion to the already fully developed destructive changes. Independent of a possible disturbance of function, which, in the case, may, to a certain extent, be explained mechanically by the collection of pus in the scala tympani and subsequent pressure upon the membrane of the round window, the presence of pus in the labyrinth attracts our interest and gives rise to the question: Are the pus corpuscles the bearers of the distinctive virus of the disease?

Deducting from observations in other infectious diseases, it is highly probable that cerebro-spinal meningitis also has its characteristic infective agent. LEICHTENSTERN<sup>2</sup> has lately demonstrated small spherical cocci, some isolated, others arranged in small irregular groups, mostly enclosed in white blood corpuscles, *but also existing outside of the cell*, in the exudation on the pia of a person who died of cerebro-spinal meningitis. The possibility, accordingly, is worthy of consideration, that some of the cocci, by virtue of their diminutive size penetrating everywhere easier than pus cells, may have entered the labyrinth with cerebral fluid earlier than the pus, and here disseminated the inflammation. In our case, the facts that the inflammatory process appeared to be less in degree in the modiolus and scala tympani—the first points exposed to the invading pus—

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<sup>1</sup> The ring-cells are not included in this species.

<sup>2</sup> Report of the allgem. ärztl. Verein of Cologne, session of March 16, 1885. *Deutsche med. Wochenschr.*, No. 23, 1885.

than higher up in the semicircular canals, furthermore that no real pus cells (ring-cells are not included) were found in the latter, would favor the view of an early and independent migration, followed by rapid increase and spread of the cocci. It must further be stated that but little pus was found in the right labyrinth, although the destructive changes in the posterior semicircular canal had already quite progressed. Since the type and characteristics of this specific germ have not yet been firmly determined, the decision of the point in question is irrelevant and impossible. We merely call attention to this point, as the presence of pus cells in the labyrinth and the attempts to explain its manner of travel from the cranial cavity will naturally lose its weight as soon as it has been firmly established that cerebro-spinal meningitis is caused by a specific virus, that the pus cells are the means of absorbing and disseminating it,<sup>1</sup> the pus corpuscles themselves not representing the real feature of the morbid process. In dwelling upon the cellular structures found in the internal auditory meatus, besides the preponderating number of pus cells, larger round cells with coarsely granular, partly black-stained contents were also observed. I am undecided whether these last cells arise from the confluence of pus corpuscles (called epitheloid cells by COHNHEIM), whether the black staining by osmic acid indicates a beginning fatty degeneration of the cell contents, namely a retrogressive metamorphosis, and whether the granules, resembling nuclei and nucleoli, have any relation to the organized virus (germs) of the disease. It will require the examination of fresher material by an expert with the use of modern staining methods to decide this. My explanation of the origin of the ring-cells is as follows: The fibrous trabeculæ, which partly constitute the arachnoidal sheath of the nerves of the internal auditory meatus, are lined with cells containing a small oval nucleus. Cells almost similar are found on the ligamentous bands of the saccules, ampullæ, and semicircular canals, the so-called

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<sup>1</sup> This is not the place to discuss the hypothesis that the pus cells absorb, and by a process of digestion destroy, the infectious organisms, according to which suppuration may be regarded as favoring restitution.

ligamenta labyrinthi of RÜDINGER. The nuclei of these cells stand out prominently, while the protoplasm itself is so delicate as barely to define the contours of the individual cell. In consequence of the inflammatory irritation (nutritive, according to VIRCHOW) these cells swell up and become detached from the fibrous framework.

Although the nucleus itself remains unchanged, the body of the cell becomes more or less distended and assumes a globular shape; a change similar to that observed in the cube-shaped cells in inflammatory processes of the respiratory mucous membrane. The unaltered nucleus adhering to the periphery of the distended cell imparts to the whole the appearance of a ring. No segmentation of the nucleus or proliferation of the cells consequent upon the inflammatory irritation was noticeable; it was rare to find two nuclei within one cell. The detachment of these cells and their presence in great numbers in various parts of the labyrinth, moreover, would indicate, that these structures do not develop but degenerate and form a portion of the detritus. The fact, that they were also observed in all the transverse sections of the bony canals containing the branches of the vestibular nerves, even in parts where pus cells had not penetrated, lends additional interest to these cells. Otherwise, it may have been assumed that these cells were identical with pus cells, and migrated from the internal auditory meatus. In general, the detachment of these cells is of minor importance. *The changes in the periosteum,<sup>1</sup> the perilymphatic spaces, and those most marked in the semicircular canals, impress me as interfering essentially with the integrity of the sense organ.*

According to COHNHEIM'S theory,<sup>2</sup> the course of the inflammation may be explained as follows:

The small, ramifying vessels between the bone and its periosteal covering are acted upon most intensely by the specific virus of the disease.

In consequence of the subsequent changes in the tunics

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<sup>1</sup> For brevity's sake, I call the fibrous, epithelial-bearing lining of the bony labyrinthine spaces periosteum.

<sup>2</sup> See Vorlesungen über allgem. Pathologie, p. 271 and 272.

and dilatation of the vessels, the current of blood is retarded. The beginning of the inflammation, or light forms of it, are marked by a fibrinous exudation. This produces a splitting up of the periosteum into layers and denudation of the bone. The passage of *white* blood corpuscles from the blood-vessels does not seem to take place. The inflammation increasing, stagnation of the blood in the vessels takes place, and is followed in places by escape of red blood corpuscles. In the severest types of inflammation, complete stasis ensues, the vessels are choked up, and *necrosis* follows. The periosteal layer and superficial lamellæ of bone become detached, and combining with fragments of thrombosed vessels, cell detritus, and coagulated exudation, form a mass of débris, filling up more or less the bony semicircular canal.

Nowhere were there traces of a productive inflammation; the appearance of one case was merely that of the severest type of inflammation and inflammatory necrosis.<sup>1</sup>

The fibrous ligaments directly attached to the periosteum of the labyrinthian cavities *convey the nutrient vessels to the semicircular canals, the ampullæ, and saccules*. Stasis also affects these vessels, and *the progress of the necrosing inflammation necessarily must lead to detachment and destruction of the membranous structures of the labyrinth*. This will readily explain the detachment, disintegration, and disappearance of the membranous semicircular canals. The ampullæ and saccules are better preserved; the changes in the periosteum, probably due to a more favorable circulatory arrangement, not having progressed so far. We intentionally call no attention to partial defects in the ligamentary bands, to variations in shape of transverse sections of the ampullæ visible in some cuts, as these changes may have been caused by the processes of decalcifying or rough handling in preparing the specimens. In dwelling upon the detritus in the vestibule and scala vestibuli, it must be considered that the periosteal lining of these parts was not sufficiently involved to *locally explain* its presence. It must

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<sup>1</sup> According to *Cohnheim* "the organized viruses of the various infectious diseases resemble that of pharyngeal diphtheria in calling forth inflammatory necrotic processes wherever deposited" (diphtheroid processes according to *Weigert*), *l. c.*, p. 484.

be assumed that the greater part of it was formed in the semicircular canals, and by means of the perilymphatic fluid deposited in the vestibule and cochlea. It cannot be doubted that a continuance of the necrotic inflammation would eventually have led to a similar detachment and destruction of the endolymphatic structures of the vestibule and cochlea. It is also possible that the circulatory arrangement of the periosteum of the cochlea differs from that of the semicircular canals. Be it as it may, the changes described in the cochlea, *i. e.*, hyperæmia and hemorrhagic extravasation into the ligamentum spirale, the presence of cells within its fibrous meshes, of pus and detritus in the scalæ, the changes thus occasioned in the consistency and chemical condition of the peri- and endo-lymphatic fluid, finally the detachment of the epithelial layer lining the ductus cochlearis, are assuredly within themselves sufficient to produce great functional disturbances of the delicate minute nerve terminations. Considering our present methods of examination, our imperfect knowledge of these parts in a normal condition, it is impossible to state whether or not the cells of the organ of Corti, and the delicate nerve fibrillæ distributed to them, were involved. The same must be said of the nerve-epithelia of the ampullæ and saccules, which are difficult to define in normal conditions. The fact that the structures of the cupula were mainly preserved, would indicate that cell changes had as yet not occurred. The cellular detritus observed in the left horizontal membranous canal probably originated from the detached and degenerated cells lining it. Similar to the ductus cochlearis and the ligaments of the labyrinth, the inflammation seems to have produced cloudy swelling and detachment of the epithelia.

It is far from my intentions to draw general deductions from the examination of a single case. If future observations will corroborate the changes as described in the semicircular canals, it will be very easy to explain the rapidity with which the auditory organ is destroyed in sporadic cases of cerebro-spinal meningitis, and further, the hopelessness of a cure. I further wish to dwell upon the ques-

tion frequently discussed, the condition of the facial nerve and its participation in the inflammatory process. Although in the case under discussion, the facial nerve in the internal auditory meatus, and for some distance in its horizontal portion, was bathed in pus and its vessels turgid (similar to LUCÆ'S case and one of the two cases described by HELLER), the clinical history does not mention any paralysis of the muscles supplied by it. The case may offer an additional example of the special resistance of the facial nerve in meningitic exudations. MOOS<sup>1</sup> has already emphasized the fact, "that in consequence of the violent course of the disease and the constant soporous state of the patient, symptoms indicating complication of other nerves (in referring to the acoustic) may not be manifested." On the other hand, the following assumption is worthy of consideration, and explains very simply the variation in the condition of the acoustic and facial nerves: Great changes or destruction of the labyrinthine structures consequent upon inflammation, will readily account for the ensuing deafness without necessitating impairment of function of the trunk of the acoustic nerve. The fact, exemplified in many cases, that the patients surviving the attack of meningitis recover entirely, excepting frequent resulting deafness and disturbances of equilibrium, demonstrates that the exudation within the cranial cavity and surrounding the nerves has been entirely absorbed. According to my view, this process of restitution may affect *the trunk* of the acoustic nerve as well as the facial and other nerves, notwithstanding existing deafness. Numerous cases of subjective tinnitus show conclusively, recognizing the labyrinthine deafness, that the acoustic nerve is not always paralyzed. This does not exclude the possibility of a *secondary* degeneration of its fibres due to cicatricial contraction of the neurilemma or lack of function. There is no reason, however, to assume that these cases are more numerous than those of facial paralysis. These last mentioned do occur now and then,<sup>2</sup> and although ZIEMSEN himself was not able to

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<sup>1</sup> Ueber Meningitis cerebr.-spin. epidemica, p. 17.

<sup>2</sup> Comp. Seggel, bayr. Intelligenzblatt, 1865, No. 46, p. 644. Quoted from Moos, *l. c.*, p. 17.

observe any disturbances of facial-nerve innervation in his own cases, he quotes several others.

Considering the symptoms, at least those in the first stage of the disease, which clearly point to an irritation rather than paralysis of the nerve, it appears that the presence of symptoms of paralysis have been too generally preconceived. Such irritation of the higher sensory nerves is generally manifested by sensitiveness to light and noises<sup>1</sup> and subjective auditory impressions; in motor nerves, by clonic or tonic spasms. ZIEMSEN speaks of *unilateral or bilateral facial spasm*, which I attribute to irritation of the fibres of the facial nerve. The involvement of this nerve in the inflammation, being indicated merely by transitory spasmodic contraction of the facial muscles, may either be overlooked or the latter symptoms be attributed to irritation of the cerebral cortex.

Nystagmus, a series of clonic spasms, strabismus, produced by tonic contractions of the ocular muscles (paralysis of the antagonistic muscles need not necessarily always exist), and contraction of the pupil further serve as indications of increased irritation of the motor nerves. In the case under discussion constant deflection of the head toward the left side was also noted, and as the left vagus nerve was found to be surrounded by pus at the autopsy, this symptom may be attributed to irritation of the left accessory nerve. It also may be assumed that only *some of the nerve fibres* were involved, the others escaping. This will easier explain the involvement of isolated muscles or sets of muscles, than a presumptive affection of the cortex of the brain or other portions of the central nervous organ. Irritation of the trifacial nerve was made manifest by the herpetic eruption, and also possibly by the conjunctivitis (involvement of the trophic nerves?). In considering the

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<sup>1</sup> Coinciding with LUCAE that in similar cases (a case of caries, communicated at the Strassburger Naturforscher-Versammlung) the wave sounds in bone-conduction directly impinge upon the trunk of the acoustic, its conducting function being unimpaired, and thus creating auditory impressions, it is possible that, notwithstanding the deafness or impaired hearing after disease of the labyrinth, sensitiveness to sounds and noises may still remain. Consequently we should be more conservative in the use of the term "nervous deafness," and ere applying the same, clearly demonstrate to what *portion* of the nervous tract we are alluding.

extension of the purulent inflammation to the neurilemma of the spinal nerve-roots, a process probably similar to that of the cranial nerves, the familiar contraction of the neck, opisthotonus, general hyperæsthesia of the skin and the joints, erythema, and urticaria eruption, are all expressions of direct irritations of the nerves. Besides spasmodic contraction of the neck, spasmodic flexion of both knees was noted in the case under observation.

Also in those cases of cerebro-spinal meningitis terminating in recovery, purulent infiltration of the neurilemma of the trunk of the nerves may accordingly have existed. Owing to the gravity of the disease, this condition may have called forth no symptoms or merely have expressed itself in those of nerve-irritation. Only in few cases, and then secondarily, does this lead to paralysis. *As the terminal apparatus of the acoustic is affected frequently, its trunk, however, not more often than that of the facial during the course of the cerebro-spinal meningitis, any variation regarding the involvement of either is only apparent.*



# ON THE MECHANISM OF CHRONIC PURULENT MYRINGITIS IN TUBERCULOUS INDIVIDUALS.\*

BY PROF. S. MOOS, OF HEIDELBERG.

(With plates ix. and x., of vol. xv., Germ. ed.)

Translated by A. SCHAPRINGER, M.D., of New York.

IN the present paper I do not propose to treat of the action of bacilli in the myringitis of tuberculous individuals. As it happened, the specimens which form the basis of this investigation were all derived from patients affected with tuberculosis. It appeared to me necessary to mention this in the title of this paper in order to prevent misunderstanding, since it is possible that the mechanism of purulent myringitis accompanying or caused by other morbid conditions than tuberculosis, if investigated, may prove different from the one here described.

## I.—*The Changes in the Malpighian Layer.*

The morbid changes of the Malpighian layer in chronic purulent myringitis have not been accurately described as yet. Under a strong magnifying power the cells composing this layer present the appearance of increased activity. Many of the nuclei appear to be very rich in protoplasm and so swollen as almost to reach the cell walls. The proliferation of the *rete Malpighi* due to this increased activity is of a threefold character:

1. There are *irregular hyperplasiæ* in the direction of the cuticular layer, showing often a diameter four or five times as large as that of the normal Malpighian layer.

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\* Read before the Section on Otology in the Convention of German Naturalists and Physicians held at Strasburg, 1885.

2. The proliferation also forms true *papillæ* (v. fig. 4, at *p*), with loops of blood-vessels between them. They are often so numerous as to extend over the entire half of a section of the membrana tympani. In the normal condition such *papillæ* are not found in the drum membrane at all, but in its neighborhood.

3. There are large and broad hyperplasiæ reaching as far as the manubrial artery, which, on cross section, present the appearance of plugs or clubs (v. fig. 1, *z*, and fig. 2).

This proliferation does not only take place in a transverse but also in a vertical direction. Hence we find often islands of proliferated Malpighian tissue within the cuticular layer (fig. 1, and fig. 7, *z*) having no connection with the main layer immediately underneath the epidermis. This is important to note, since these islands can become the seats of cholesteatomatous degeneration. In such a case a primary cholesteatomawould be found in the midst of the cuticular layer the origin of which would have to be explained as above, and would be something different from the endothelial cholesteatoma of the drum membrane as described by Wendt.

Sometimes a row of spindle-shaped cells is found at the bottom of the Malpighian stratum with their axes directed toward the epidermis (fig. 3, *sp*). These may be derived either from the Malpighian stratum by the process of indirect nuclear segmentation, or, as to me seems more probable, from wandering cells of the inflamed cutis which have assumed the shape of spindles.

All the different changes of the Malpighian layer here described may be found in one and the same subject, except the spindle-shaped cells, which I have found in cross-sections of the membrana flaccida only.

## II.—*The Changes of the Cuticular Layer.*

The histological elements of the cuticular layer are displaced to some extent by the above-described plug-shaped proliferations of the Malpighian layer. Wherever it is not so displaced, it presents the following appearances:

The normal blood-vessels are mostly dilated and gorged

T<sup>2</sup>

Fig. 1



Fig. 2

37



Fig. 3



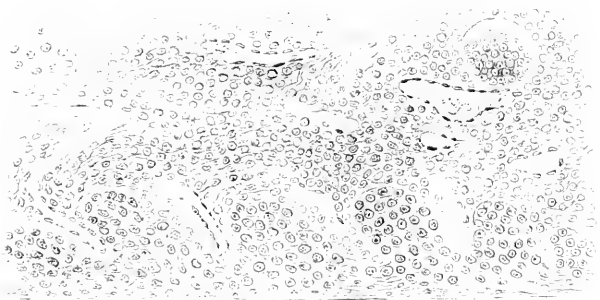
37

Fig. 4

cs

p

e



34



Fig 5



Fig 6

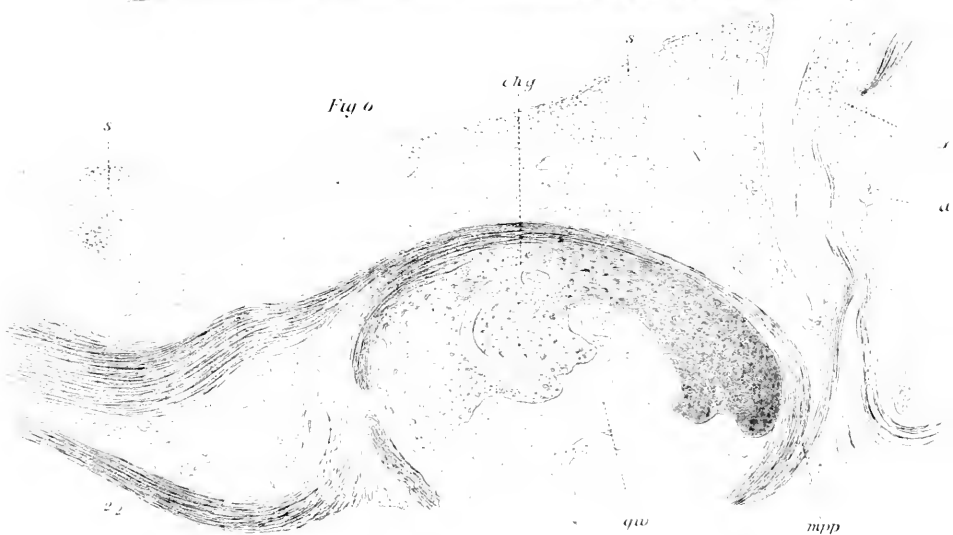


Fig 7





with blood corpuscles. There are besides numerous newly formed blood-vessels, especially in the membrana flaccida, which, as is well known, not only possesses a vascular net of its own, but also many perforating arteries and veins—the former supplying nutrition to the adjacent mucous membrane and the neck of the hammer, and the latter carrying off the blood of a part of the tympanic cavity to the manubrial veins in the cuticular layer. For this reason the membrana flaccida presents a truly cavernous appearance in several places. The neighborhood of the external wall of the vessels is more or less infiltrated with round cells, and the interstices of the cuticular connective tissue are studded with round, multinuclear and pus cells.

The newly formed connective tissue, also to be found, is the product partly of round cells which have been transformed into spindle cells, and partly of the proliferation of the mural elements of the blood-vessels. At a certain stage of purulent inflammation these cells coalesce, and the resulting connective-tissue hyperplasia causes the obliteration of the normal as well as the new-formed blood-vessels. (Thickening of the cuticular layer of the drum membrane, fig. 3, *cs.*)

The inflammatory changes of the cuticular layer here described extend into the wall of the external auditory canal for several millimetres. For this reason the limits of the membrana tympani become blurred, and the membrane itself, when examined by the speculum, appears flattened and smaller.

Besides these products of proliferation, which in some instances were found to be most pronounced in the membrana flaccida, there are also to be met with the results of *destructive changes*, especially in the portion of the cuticular layer corresponding to the handle of the hammer. In this region, which is the most vascular of the cuticular layer, the purulent infiltration is most pronounced, causing the destruction not only of the cuticular layer itself, but also of the adjacent periosteal layer of the handle. In consequence of this all the layers of the drum membrane covering the lateral aspect of the handle disappear, leaving bare the carious bone (fig. 1 and figs. 6 and 7, *chg.*).

### III.—*The Changes of the Mucous Membrane.*

The inflammatory changes of the mucous membrane and the tissue hyperplasia caused by them, on the whole, differ only little from those found in the cuticular layer. Besides the enlargement of the normal blood-vessels, new-formed vessels are to be found engorged with blood. The connective-tissue stroma of the mucous membrane is studded with round and pus cells. This formation of cells is sometimes so abundant that in some well-preserved cross-sections a broad zone of products of exudation can be seen clinging to the epithelial surface of the mucous membrane. As a rule, the hyperplasia of the mucous membrane is most pronounced in the region of the handle and at the inner surface of the ventricular ligament. At the latter place the infiltration is often so exuberant as to completely fill the ventricle. New-formation of connective tissue is not met with so often, and to such an extent, in the mucous layer as in the cuticular layer. Beginnings of newly-formed connective tissue are sometimes seen at the inner surface of the ventricular ligament (fig. 5). This forms the preliminary stage of the subsequent obliteration of the ventricle by new-formation of connective tissue.

In a previous paper on lacunar caries of the handle of the hammer I have demonstrated that the mucous membrane in the region of the handle, the deeper layers of which form the latter's periosteum, may be undermined and become detached by purulent destruction, and that by the formation and subsequent increase of granulation tissue at the inner surface of the mucous membrane caries of the handle will result. This process is met with very often in purulent myringitis of tuberculous subjects, and as the same process may also take place on the lateral side, as described above, the carious destruction of the handle will reach its maximum at the point where the destructive process attacking the bone from opposite sides, will meet.

This does not exclude a simultaneous proliferation and thickening of the periosteum of the handle. While carious destruction is going on, on both the medial and the lateral side, periostitis may flourish on both the anterior and posterior edges of the manubrium (fig. 6, *vp*).



IV.—*The Changes of the Substantia Propria.*

Besides those changes which concern the *substantia propria* as far as it helps to form the manubrial periosteum and which have been described before, there are also other changes which are more of a passive nature and are due to the mechanical influence of the inflamed and infiltrated layers covering the *substantia propria*. I have never been able to find *true vascular inflammation* of the *substantia propria* in the myringitis occurring in tuberculous individuals. The blood-vessels perforating the *substantia propria*, which have been described by Kessel and myself, seem to simply keep their character as blood conduits without taking any active part at all in the inflammatory process. They are more or less filled with blood, show no histological changes of their walls, nor is there any perivascular small-celled or purulent infiltration. Nor does the purulent infiltration of other portions of the *substantia propria* ever reach such a degree as in the cuticular and mucous layers except in some places immediately adjoining these layers. As a rule, the *substantia propria* suffers angular and arched displacements in consequence of the pressure of the enormous mass of exudation (figs. 1 and 7).<sup>1</sup> If this pressure increase still more, the *substantia propria* will be ruptured by the forcible displacement of its fibres, which, instead of following a transverse direction, will be found to run obliquely and, by this circumstance, reminding one of the smooth muscular fibres which Leydig found in the drum membrane of the frog (figs. 1 and 7).

In other places the *substantia propria* becomes ruptured less by pressure than in consequence of the swelling and maceration of its own tissue, its fibres being displaced in a transverse direction (fig. 5).

Though it is possible that these two processes may co-exist, I have never had an opportunity to observe such a combination.

Whenever the *substantia propria* is ruptured hemorrhage takes place, the results of which can be found in the meshes

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<sup>1</sup> After the subsidence of the inflammation the corresponding places, when examined with the ear-speculum, will appear as irregular, partial opacities.

of the thickened connective tissue of the cuticular layer (compare fig. 1).

This hemorrhage may also take place into the mucous tissue or into the tympanic cavity itself, or into both at once, but I do not have any specimens demonstrating these possibilities.

*Hemorrhagic Infiltration and Hemorrhagic Inflammation*  
(compare fig. 5).

*Hemorrhagic infiltration* has to be distinguished from the hemorrhagic effusion into the interstices of the cuticular tissue as described above. The hemorrhagic infiltration may either be circumscript or diffuse. The latter form may comprise the whole specimen under investigation, even including the carious lacunæ of the handle. In order to properly understand the mechanism of its causation, we must study the normal condition of the blood circulation in the drum membrane.

There are certainly few areas supplied by blood-vessels in the human system or in that of animals which present such an abundance of capillary anastomoses as the membrana tympani.<sup>1</sup>

These favor rapid equalization of disturbances of circulation, which is also favored by the arrangement of the venous blood-channels in the several layers of the membrane as described in the paper just quoted. If the drum membrane becomes inflamed, the rupture of the walls of blood-vessels will be delayed long by reason of the presence of these capillary anastomoses. However, if the inflammatory process is of long duration or of a very severe character, this automatic safety-apparatus becomes insufficient, there is a general breaking down of the walls of the over-distended blood-vessels, old and new, diffuse hemorrhage takes place, and instead of a purulent we have a hemorrhagic inflammation. In some severe cases of otitis media this process takes place during the first stages of the disease, constituting considerable hemorrhage. D. B. St. John

<sup>1</sup> On the Blood-vessels and the Circulation in the Membrana Tympani and the Manubrium Mallei. These ARCHIVES, vol. vi., p. 574.

Roosa ("Diseases of the Ear") has described this affection as *otitis media hæmorrhagica*. He thinks that it is due more to rupture of the blood-vessels than to exudative processes, in which opinion I cannot coincide, because if it were so the hemorrhage would be the only symptom, whereas the processes of exudation are never wanting, though sometimes they are of short duration only. This shortness of duration is due to the fact that nature relieved the parts by bleeding in a more effectual manner than it could ever be accomplished by artificial means. A copious hemorrhage in the beginning of acute purulent otitis media ought therefore always to be regarded as a favorable symptom.

*Synopsis of Measurements Made of the Single Layers of the Drum Membrane in a State of Acute Purulent Inflammation.*

Thickness of the mucous membrane from 0.4 to 0.5 mm; thickness of the cuticular layer from 0.13 to 0.16 or 0.2 mm; thickness of rete Malpighi, 0.3 (normal) to 0.19 mm; thickness of membrana propria, average of five measurements (0.07, 0.05, 0.01, 0.02, 0.03 mm), 0.036 mm; thickness of cuticular layer of membrana flaccida, 0.65 to 0.75 mm; thickness of hemorrhagic infiltration in the posterior pocket, 0.436 to 0.545 mm; thickness of thickened cuticular layer in later stages of inflammation, 0.1 to 0.2 mm.

The greatest increase in thickness is shown by the membrana flaccida, the mucous membrane coming next. The variations in the thickness of the membrana propria depend upon whether it happens to be intact or in a stage of swelling and maceration. The variations in the thickness of the rete mucosum depend upon the degree of inflammation participated in by its component cells.

*Explanation of Plates ix. and x.*

Fig. 1. Section across the middle of the hammer and the adjacent parts of the drum membrane (Hartnack  $\frac{3}{2}$ , tube at zero) of a man twenty years old who died of chronic tuberculosis and who had suffered from otitis media purulenta of the right ear for five months preceding his death. The perforation was in front of the

handle which was drawn towards the promontory. The grayish-red remnant of the drum membrane was seen during life to be thickened.  $S$  = mucous membrane with several blood-vessels, thickened, in parts considerably so, by small-celled and purulent infiltration.  $p$  = membrana propria and periosteum.  $T''$  = a portion of the posterior half of the membrana tympani, from two to three times as wide as  $T$  = the neighborhood of the perforation. The large dark portion adjoining  $T$  represents the handle of the hammer which is carious on its lateral side. The carious part which is characterized by being made to appear light in the drawing and by sinuous contours, consists of vascular granulation tissue. The arrow ( $\rightarrow$ ) points in a lateral direction, *i.e.* towards the external auditory canal. The lateral surface of the handle is denuded, all the layers of the drum membrane including the periosteum having been destroyed by suppuration. There where the layers are still preserved ( $T''$ ) they present the following changes: The mucous membrane is thickened by infiltration, though less so than in the region of the handle. The membrana propria ( $p$ ) shows normal width and structure for some distance, but there where the yellow hemorrhagic lacunæ appear, its fibres are thrust asunder. The cuticular layer is moderately vascular and shows small-celled and purulent infiltration as well as connective-tissue hyperplasia. From the rete Malpighi club-shaped extensions ( $z$ ) are invading the cuticular layer, as far as the manubrial artery ( $ha$ ).

Fig. 2 shows the structure of the club-shaped extensions of the rete Malpighi under a higher magnifying power (Hartnack  $\frac{3}{4}$ , tube at zero).

Fig. 3. A small portion of a section taken from the region of the membrana flaccida and comprising the epidermis ( $e$ ), the rete Malpighi ( $rm$ ) and the adjacent portion of the thickened cuticular layer (Hartnack  $\frac{3}{4}$ , tube drawn out). The cells of the rete mucosum are somewhat increased in number, and their nuclei, which are rich in protoplasm, almost reach to the cell wall. A single row of spindle cells ( $sp$ ) with their large diameter looking towards the epidermis, is placed between the deepest row of Malpighian cells and the most superficial elements of the cuticular layer ( $cs$ ). This layer has lost a great deal of its vascular supply, and consists mainly of connective tissue, the rest being made up of uninuclear and a few multinuclear cells ( $vz$ ).

Fig. 4. A portion of a section of the membrana flaccida in a

state of chronic purulent inflammation (Hartnack  $\frac{3}{4}$ , tube at zero). The epidermic layer (*e*) is narrow, the rete Malpighi is developed into veritable papillæ (*p*), with loops of blood-vessels supplied from the cuticular layer (*cs*) between them. Only one third of the thickness of the hyperplastic cuticular layer is represented in the drawing. It is infiltrated by round and pus cells, and pervaded by blood-vessels, partly empty and partly filled with blood corpuscles.

Fig. 5. A portion of a section through the drum membrane and the posterior ventricular ligament (Hartnack  $\frac{3}{4}$ , tube at zero). Chronic purulent myringitis. *S* = mucous membrane. *tb* = ventricular ligament. *mp* = membrana propria. *cs* = cuticular layer. *erm* = epidermis and rete Malpighi. *a* = an artery of the cuticular layer. The mucous membrane, which is considerably thickened in some places, and the cuticular layer are permeated by dilated vessels and exhibit hemorrhagic infiltration, the mucous membrane in its entirety and the cuticular layer only in portions. At the inner surface of the ventricular ligament (at the left side of the drawing) there are strings of newly formed connective tissue, indicating a preliminary stage of the obliteration of the pouch. At the right side of the drawing the fibres of the ligament are separated from each other and displaced in a transverse direction.

Fig. 6. Lateral caries of the handle and periostitis of its anterior edge. Transverse section of the handle and the tympanic membrane, as in fig. 1 (Hartnack  $\frac{3}{2}$ , tube drawn out). *chg* = carious handle of the hammer. *gw* = granulation tissue showing hemorrhagic infiltration. A portion of the handle and the lateral aspect of the adjacent parts of the drum membrane have been destroyed. The arrow ( $\rightarrow$ ) points away from the medial side. *S* = thickened mucous membrane with hemorrhagic infiltration. *vp* = thickened periosteum. *mpp* = membrana propria, in connection with the periosteum, which in this place is intact. At *x* the membrana propria is broken through and displaced by masses of infiltration. *a* = an artery of the cuticular layer. Between the fibres of the thickened periosteum there are numerous blood-vessels with hemorrhagic infiltration of their neighborhood.

Fig. 7. A cross-section of the carious end of the hammer and the adjacent membrana tympani (chronic purulent inflammation) (Hartnack  $\frac{3}{2}$ , tube drawn out). The arrow ( $\rightarrow$ ) points in a medial direction. *chg* = carious handle. *gw* = granulation

tissue. *S* = mucous membrane, thickened and exhibiting hemorrhagic infiltration. *mp* = membrana propria, displaced in a lateral direction and showing sinuosities and angular curves. *erp* = epidermis and rete Malpighi, with the plug-shaped projections of the latter into the subjacent tissue. *cs* = vascular and infiltrated cuticular layer, partly pervaded by hyperplastic connective tissue. *a* = an artery of the cuticular layer. *z* = transverse section of a Malpighian plug.

## ON CYSTS OF THE AURICLE.

BY H. SELIGMANN, OF FRANKFORT-ON-THE-MAIN.

Translated by A. SCHAPRINGER, M.D., of New York.

THE observations on formation of cysts in the auricle, published by Hartmann, in the last volume of these ARCHIVES (p. 133), have induced me to publish the following case, which tends to corroborate this author's view concerning the difference between the formation of cysts and that of hæmatoma.

Herr W., æt. thirty-five, of robust and florid appearance, wearing a full blonde beard, and with sound intellect, applied to me on May 23, 1885, on account of a swelling of two months' duration, occupying the usual situation of othæmatoma between the upper portions of the helix and the anthelix of the right ear. The skin was very tense and somewhat hot. The swelling itself had the size of a walnut, was round, tense, smooth, and not tender to the touch. The rest of the cartilage was normal. Traumatism could be positively excluded. The patient not consenting to an incision, I tapped the swelling by means of a Pravaz syringe, and evacuated about 3 *ccm* of a thick, transparent fluid of a light-yellow color. The place of the puncture was covered with a piece of adhesive plaster, and the pinna being padded with cotton, a bandage was applied.

The patient did not put in appearance a second time, but through a friend of his I learned, about five months later, that a little of the fluid had collected again after the puncture, but that it disappeared again, and that the ear now presented the same appearance as the other.

The morphological elements contained in the liquid were some

mucous threads, some white and very few red blood corpuscles. There was no trace of any products of the disintegration of red blood corpuscles. This circumstance, taken in connection with the absence of traumatism and of pain, and the intact general health of the patient, leaves no doubt that this was not a case of othæmatoma, but of cyst.

In regard to the treatment, I would say that in the next case I would first try multiple puncture, and incise only in case this should fail to cure. Massage and a compressive bandage would be connected with more inconvenience than the slight discomfort of the patient would warrant.



# REPORT ON THE PROGRESS OF OTOTOLOGY IN THE FIRST HALF OF THE YEAR 1886.

## I.—NORMAL AND PATHOLOGICAL ANATOMY, HISTOLOGY, AND PHYSIOLOGY OF THE EAR AND NASO-PHARYNX.

BY A. BARTH, OF BERLIN.

Translated by Dr. JEFFERSON BETTMAN, New York.

### ANATOMY OF THE EAR.

1. Dr. EM. KAUFMANN, of Prague. Annular ridges in the cutis of the external auditory meatus (communication from the laboratory of Prof. Schenk in Vienna); 1 plate. *Wiener med. Jahrb.*, 1886, Heft 5, p. 201.

2. VOLTOLINI. A study of the auditory teeth and their blood-vessels in the cochleæ of human beings and mammals. *Virchow's Arch.*, Bd. civ., p. 109.

3. Dr. BENNO BAGINSKY, Docent in Berlin. The origin and central course of the acoustic nerve in rabbits; 1 plate. *Virchow's Arch.*, Bd. cv., pag. 28 (July 3, 1886).

4. Dr. EDINGER, of Frankfurt. The origin of the acoustic nerve and the direct sensory cerebellar tract. *Neurolog. Centralbl.*, 1886, pag. 286.

1. Most authors have described a series of papillæ, arranged in rows parallel to the axis of the auditory meatus, in the lower portion of the osseous meatus. The author demonstrates that the appearance of papillæ is simulated by transverse sections of ridges, which are arranged vertically to the axis of the auditory meatus, in other words, circular, parallel with the periphery of the tympanic membrane. This arrangement of ridges is found in embryos, in the new-born, in adults, and in animals. They are principally

found in close neighborhood of the membrane, and seldom extend around the entire circumference of the meatus, being principally observed in the floor of the canal. Only in exceptional cases are they observed continuing along the band of fibrous tissue, which passes from the upper wall of the meatus on to the membrane.

2. Both in human beings and animals, VOLTOLINI has comparatively seldom found the capillaries of the crista filled with blood corpuscles. The reviewer has frequently observed this injection in human beings. It can be demonstrated with nicety in specimens stained with picro-carmin and examined with a low power. The blood corpuscles stand out, stained a glistening bright yellow with sharp dark contours.

3. These investigations were conducted under Munk's directions. Similar to Gudden's experiments, they were made on young animals, the labyrinth being destroyed through mechanical means. After a period of seven to eight weeks the animals were killed, and the brain, medulla oblongata, and the petrous portion of the temporal bone were examined in series of microscopical sections. He advises the operation from the neck, penetrating near the articulation of the lower jaw into the depth, perforating the tymp. memb., and then trephining or boring into the labyrinth, as the simplest method. In his successful attempts the animals recovered without displaying any disturbances of co-ordinate muscular action. In two of those which showed disturbances of motion, serial microscopic sections were made; in one there was found marked degeneration of the cochlea and a beginning atrophy of the posterior acoustic and the facial roots, the vestibule (? Rev.) and anterior root of the acoustic remaining intact. In the other, the entire labyrinth and both roots of the acoustic were normal, while a state of complete atrophy, extending inwards to its nucleus, affected the facial nerve. There was also a co-existing degeneration of the pyramidal tract on the same side.

4. The investigations were made on human beings, both in adult and foetal states, and on cats. The results are as follows: (1) The posterior root of the acoustic nerve originates in the so-called nucleus acustici anterior. This is in connection (*a*) with the superior olivary body of the crossed side by means of a bundle of fibres called the "corpus trapezoides," (*b*) with the superior olivary body of the same side by a few fibres, (*c*) with the inner acoustic nucleus by a series of arch-shaped fibres which enclose the restiform body. Besides this, the author demonstrates con-

nections of the superior olivary body with the cerebellum and the nucleus of the abducens nerve. (2) The anterior root originates in the nucleus acustici internus. This is also in connection with the superior olivary body and the nucleus of the abducens through bundles of thin fibres. A third system of fibres, comprising part of the acoustic, is formed by a branch of the "direct sensory cerebellar tract." Under this nomenclature, Edinger describes a great portion of the tract called by Meynert and others "the inner division of the cerebellar peduncle." This bundle of fibres, enclosing the nucleus of Deiters, is in no relation with the acoustic nerve.

ANATOMY OF THE NASO-PHARYNX.

1. Dr. E. BAUMGARTEN, of Budapest. The causes of deflection of the nasal septum. *Deutsche med. Wochenschr.*, 1886, No. 22, p. 373.

2. Prof. E. ZUCKERKANDL, of Graz. Adenoid tissue in the nasal mucous membrane; 1 plate. *Wiener med. Jahrb.*, 1886, Heft 5, p. 219.

3. Dr. EM. KAUFMANN, of Prague. The function of the olfactory and epithelial cells in the olfactory region. (A communication from the laboratory of Prof. Schenk, in Vienna.) *Wiener med. Jahrb.*, 1886, p. 79.

4. CHIARI. Neoplastic growths of the nasal septum. *Rev. mens. de laryng., d'otologie, et de rhinol.*, 3, p. 121.

5. Prof. F. W. ZAHN, of Geneva. A contribution to the study of tumors. No. 5: Cysts containing ciliated epithelium in the naso-pharyngeal space. *Deutsche Zeitschr. f. Chir.*, Bd. xxii., p. 392.

6. W. WALDEYER. A contribution to the normal and comparative anatomy of the pharynx, with special attention to the deglutitory passage. A paper read before the Royal Prussian Academy of Sciences of Berlin, Feb. 25, 1886.

1. The author rejects the various theories regarding the origin of deflection of the nasal septum as unsatisfactory, and looks upon the pressure exerted by the swollen inferior and middle turbinated bones as the probable cause.

2. The author examined the nasal mucous membranes of human beings and various animals (dog, cat, sheep, hog, horse, deer, calf, hare) and found an almost identical condition in all. A sparse infiltration of lymphatic cells was found, as a rule. The presence of extensive adenoid tissue in the shape of diffuse infil-

trations or follicles was not general. The structures described as follicles also show a reticulum, which, besides the conglomeration of cells, constitutes the elements of a normal follicle. The adenoid tissue is principally found in the respiratory fissure, notably in the posterior segment. Here it frequently continues from the pharyngeal tonsil, extending on to the nasal septum. The irregular occurrence of follicles in the nasal mucous membrane may be regarded as normal, and is analogous to the conjunctival follicles.

3. The author attempts to decide the question, whether or not the epithelial cells and the olfactory cells of the olfactory region are identical or differ in morphological and physiological respects. He conducted his investigations on frogs, and concluded that the epithelial cells are the original and principal structural elements lining the olfactory portion of the mucous membrane, and that the olfactory cells develop from these.

5. The author describes three cases of cysts lined with ciliated epithelium, which were accidentally discovered in post-mortem examinations, and occupied the upper pharyngeal wall. External to the cyst walls was found a layer of adenoid tissue containing no glands; upon this was a layer of fibrillated connective tissue rich in glands but containing few cells. In the three cases a pit-like depression was noticeable on the anterior face of the basilar bone. The cysts were uni- and multi-locular, and in their position and construction corresponded to the pharyngeal bursa.

6. The author treats of the precautionary conditions existing in the larynx to prevent "false swallowing" in the act of deglutition.

#### PHYSIOLOGY OF THE EAR.

1. Dr. S. S. ISTAMANOFF. The relation existing between variations of temperature in the external auditory meatus and the cerebral circulation (from the physiol. laboratory of Prof. Tarchanoff, of St. Petersburg). *Arch. f. d. ges. Physiol.*, Bd. xxxviii., pag. 113.

2. Is. STEINER, of Heidelberg. The semicircular canals of the shark. *Kgl. preuss. Acad. d. Wissensch. zu Berlin*, 20 May., 1886. Reprint.

3. Dr. J. L. ECKERT, of Laufenburg. A contribution to the function of the semicircular canals. *Correspondenzbl. f. Schweizer Aerzte*, 1886, pag. 11.

4. Dr. W. KIESSELBACH, of Erlangen. Remarks on the above-mentioned article. *Ibid.*, pag. 259.

5. Dr. J. L. ECKERT, of Laufenburg. Counter-remarks on Kiesselbach's observations. *Ibid.*

6. VICTOR HENSEN, of Kiel. Investigation on the perception of noises (with reference to E. Brücke's review of a paper on this subject). *Arch. f. Ohrenheilk.*, Bd. xxiii., pag. 69.

1. In order to investigate the relation existing between the temperature of the external aural canal and the cerebral circulation, the author made a series of observations in a boy aged twelve, who suffered from a partial defect of the frontal bone, and who readily demonstrated any increase in the volume of the brain. He instituted a series of hot and cold hand-baths with simultaneous thermometric observations in the external meatus. He arrived at the conclusion that, in all cases without exception, immersions of the hands in cold water produced a reduction of the temperature in the extremities and also in the external meatus. Warm baths increased the temperature. The use of cold hand-baths called forth an increase in the volume of the brain with the simultaneous reduction of temperature in the auditory meatus. Warm baths were productive of an opposite state of affairs. These investigations are interesting in demonstrating also that cooling one portion of the body will produce a reduction of the entire body temperature, and that the blood, being forced out of the part exposed to the cold by the contraction of the blood-vessels, calls forth a secondary dilatation of the vessels in other portions of the organism, as demonstrated in the brain. Raising the temperature in a localized part has the opposite effect.

2. Compared with other animals the shark, due to its great power of resistance and especially to the comparative facility of carrying out the operations required, is very much adapted as a subject for physiological investigations on the semicircular canals. It will be futile to expect any disturbances of locomotion after destroying one or all three of the semicircular canals on one or both sides in the shark. This shows conclusively that the canals in the shark have no connection with the state of equilibrium. The author also discusses the question in relation to other animals, and dwells in detail upon the sources of error which led other investigators to opposite conclusions.

3, 4, 5. ECKERT, basing his conclusions more upon a résumé

of the literature of the subject than personal investigations, shares the view that the semicircular canals with their ampullæ are in connection with the organ of muscular co-ordination. He regards the pendulous motions following section of the canals the principal proof to substantiate his view. He considers the dichotomous division of the acoustic nerve another proof in favor. KIESSELBACH, sharing the opposite view, claims that the pendulous motion is absent in some cases after section of the canals, and that the entire question is by no means settled. In answering this, Eckert asserts that disturbances of co-ordination are the rule, and this in itself renders it highly probable that the apparatus of the semicircular canal is in relation with the sense of muscular co-ordination. The discussion contributes nothing new to our knowledge on this subject.

6. As it is difficult to understand this article, without dwelling in extenso upon the various publications to which it refers, and which, by the way, as yet have not been reviewed in this journal, reference to it will be reserved for the future.

#### PHYSIOLOGY OF THE NASO-PHARYNX.

I. EMIL FISCHER and FRANZ PENTZOLD, of Erlangen. The sensibility of the sense of smell. *Biolog. Centralbl.*, Bd. vi., 1886 (from a review in the *Deutsch. med. Zeitg.*, p. 429).

I. VALENTIN has demonstrated that a current of air, containing in 1 ccm  $\frac{1}{30.000}$  mgrm of bromine, or  $\frac{1}{600.000}$  mgrm of sulphuretted hydrogen, or  $\frac{1}{2.000.000}$  mgrm of oil of roses, will convey the characteristic odors of these agents. Taking into calculation the quantity of air requisite to produce an olfactory sensation, the strength of the volatile agents is as follows:  $\frac{1}{600}$  mgrm of bromine,  $\frac{1}{6.000}$  mgrm of sulphuretted hydrogen, and  $\frac{1}{20.000}$  mgrm of oil of roses. The authors have discovered that the action of mercaptan and chlorphenol is by far more intense than the oil of roses. The odors of chlorphenol, in the proportion of  $\frac{1}{230.000.000}$  mgrm in 1 ccm of air, and mercaptan,  $\frac{1}{23.000.000.000}$  mgrm in 1 ccm of air, were still appreciable. According to Valentin's computation, the quantity of air considered, but  $\frac{1}{400.000.000}$  mgrm of chlorphenol and  $\frac{1}{400.000.000}$  mgrm of mercaptan are necessary to impart the characteristic odors. Accordingly, the sense of smell, in some cases, is a far finer test than the most delicate methods of investigation—for example, spectral analysis.

II.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, OF BERLIN, AND ED. SCHULTE, OF MILAN.

GENERAL LITERATURE.

1. Dr. KRETSCHMANN. Report of the Royal University Ear clinic at Halle for 1885. *Arch. f. Ohrenheilk.*, Bd. xxiii., p. 217.
2. Prof. DE ROSSI. Report of fourteenth year of aural instruction. Rome, 1886.
3. Dr. W. KIRCHNER. Report of the aural division of the University Policlinic of Würzburg for 1884 and 1885. *Münchener med. Wochenschr.*, No. 10, 1886.
4. SCHMIEGELOW, of Copenhagen. Report of the ear, nose, and throat cases treated in the General Hospital. *Hospitalstidende*, Bd. iii., No. 8.
5. MATHEWSON, PROUT, and RUSHMORE. Seventeenth yearly report of the Brooklyn Eye and Ear Hospital for 1885.
6. Dr. J. J. CHISOLM. Eighth annual report of the Presbyterian Eye, Ear, and Throat Hospital of Baltimore for 1885.
7. Dr. GHERARDO FERRERI. Surgical therapeutics of diseases of the ear. *Lo Sperimentale*, 1886, No. 3.
8. A. GRAHAM BELL. The possibility of educating the hearing of deaf-mutes. *Trans. Amer. Otol. Soc.*, 1885.
9. Dr. J. BARATOUX. Syphilis of the ear. Extract of the *Revue mensuelle*, etc., Paris, 1886. Delahaye and Lecrosnier.
10. Dr. B. ST. J. ROOSA. Presbykuisis. *Trans. Amer. Otol. Soc.*, 1885.
11. Dr. L. ROUGIER, of Lyon. Deux cas de lypémanie avec délire de persécution caractérisé par des hallucinations de l'odorat, du goût et de l'ouïe consécutives à des altérations de la muqueuse buccale, nasale et naso-pharyngienne et du squelette des fosses nasales. *Revue Mens. de Laryngol.*, etc., No. 5, 1886.
12. G. SETTERBLAD. A case of galvanic acoustic hyperæsthesia. *Hygiða*, Bd. xlv., p. 164.
13. W. KIESSELBACH, of Erlangen. Study on tinnitus aurium. *Monatsschr. f. Ohrenheilk.*, 1886, No. 4.
14. LAURENCE TURNBULL. Some rare forms of tinnitus aurium, subjective and objective. *The Therapeutic Gazette*, March 16, 1886.

15. Dr. LONGHI. Bilateral dry middle-ear catarrh. Auditory scotoma on left side. *Bolletino delle malattie dell' orecchio*, etc., Anno iii., No. 6.

16. Dr. E. BAUMGARTEN. Propagation of hearing to the opposite side. *Arch. f. Ohrenheilk.*, Bd. xxiii., p. 122.

17. Prof. A. LUCÆ. Criticisms and new facts in tuning-fork tests. *Arch. f. Ohrenheilk.*, Bd. xxiii., p. 122.

18. H. KNAPP. On the desirability of adopting a uniform method of expressing the results of testing the acuteness of hearing. *Trans. Amer. Otol. Soc.*, 1885.

19. Dr. WEIL, of Stuttgart. Two minor modifications of Politzer's method of inflation. *Monatsschr. f. Ohrenheilk.*, 1886, No. 5.

20. Dr. MÉNIÈRE. Catheterization of the Eustachian tube. *Gaz. des Hôp.*, 1886, No. 34.

21. Dr. LANCEREAUX. Syphilitic papulo-pustular eruption following and due to catheterization of Eustachian tube. *Gaz. des Hôp.*, 1886, No. 25.

22. C. KELLER, of Cologne. Former and recent communications on peroxide of hydrogen ( $H_2O_2$ ). *Monatsschr. f. Ohrenheilk.*, 1886, No. 6.

23. C. H. BURNETT. The local use of cocaine and brucine in diseases of the ear. *Trans. Amer. Otol. Soc.*, 1885.

24. S. S. BISHOP. Cocaine and other analgesic means in otology. *Four. Amer. Med. Assoc.*, Feb. 20, 1886.

25. E. E. HOLT. Does cocaine increase the congestion, while diminishing the pain, in acute inflammation of the middle ear? *Trans. Amer. Otol. Soc.*, 1885.

1. KRETSCHMANN'S report of the ear clinic at Halle for 1885 treats of 1039 patients presenting 1159 cases. The operative cases are of greatest interest, principally those affecting the mastoid process. Of these 32 were operated, including 16 acute cases, all but two terminating in recovery, and 16 chronic cases, of which six were healed, eight improved, and two ended fatally. The fatal termination in one of the acute cases was caused by septic meningitis, set up by the entrance of purulent masses through a fissure in the thin shell of a rachitic bone caused during stripping off the periosteum. Death in the second acute case was due to pneumonia, the operation and healing of the wound having progressed favorably



for three weeks. The fatal termination in both chronic cases was due to pyæmia ; in one case setting in nine days after the operation, in the other already on the same day. The author, based upon Schwartz's experience, claims that the operation in the last case was justifiable, if not necessary, and refers to an instance within his own experience in which an operation at this stage of the disease saved the patient. Among the detailed clinical histories of the individual cases is one of chiselling of the antrum, in which a communication with the external auditory canal was established only twenty-five days after the operation.

The author describes in full two cases of exfoliation of the necrosed cochlea, one of which was considered a case of primary necrosis of the labyrinth ; two cases of facial paralysis due to cauterizations of the wound canal in mastoid operations, a case of primary periostitis of the mastoid process probably produced by the irritation of aspergillus growths in the external meatus ; also three cases of removal of the hammer. He furthermore describes a case of labyrinthian disease following diphtheria, which was greatly benefited, almost cured, by the use of pilocarpin, and another case of reflex epilepsy called forth by disease of the ear. Three cases of aural affections due to syphilis, ulcers in one being situated on the posterior pharyngeal wall, in the other on the soft palate, and in the third on the tonsils, all being treated locally, in connection with antisyphilitic constitutional treatment, with the galvano-cautery, induce the author to lay special stress on the topical treatment. The reviewer has seen the same favorable result in a number of cases treated similarly, but at the same time has observed equally as good and rapid results in other cases treated exclusively with antisyphilitic agents, no local medication being adopted. The galvano-cautery accordingly is not an absolute necessity in converting syphilitic into benign ulcers. Solutions of sublimate have been introduced in Schwartz's clinic as an antiseptic during the last year. In cleansing the ear in chronic otorrhœa the strength of the solution has been 1:5,000, in operations on the mastoid process 1:1,000, and during the period of after-treatment from 1:3,000 to 5,000. The use of lactic acid in caries of the middle ear has also been tested. The use of a 15 to 20 % solution produced such pain, however, that this mode of treatment had to be abandoned. The use of iodine preparations, iodol, as recommended by Mazzoni of Rome, was followed by more favorable results. A solution of 2.0 to 16.0 of alcohol and

34.0 of glycerine was applied in those cases of caries in which the bones were necrotic. Immediately after the first application, the amount of secretion diminished and the fetor disappeared. S.

2. During the winter of 1884-85, 583 ear patients were treated in the ear clinic of Prof. Rossi, of Rome, this being the only institution of its kind in Italy. Of 25 cases of acute hyperæmia of the middle ear, observed principally from February to the end of April, all, with the exception of five cases which passed from observation, were entirely cured. The author, who formerly made paracentesis in all these cases, now restricts himself to those in which there is great pain; his results are just as good. Rossi, in dwelling upon the diagnosis of acute purulent middle-ear inflammation, disagrees with those authors who claim that the membrane is more or less convex in shape in cases of serous or purulent exudation in the tympanic cavity. Due to the usually co-existing swollen condition of the Eustachian mucous membrane and the consequent lack of ventilation of the middle ear, the membrane is generally more concave than normally. The resistance of the fibrous layer of the membrane is much too great to be overcome by the pressure of an accumulation within the tympanic cavity. Also, in these cases, the author made paracentesis only in those in which great pain existed. After making a long incision the ear was treated with insufflations of boracic acid. In small perforations this mode of treatment was not considered practical; either the opening was enlarged to obviate the plugging up of the perforation by the powder, or the powder was applied dissolved in glycerine. It is worthy of mention, that Rossi thus prevented these cases from becoming chronic. Calomel acted efficiently in cases of mucous secretion and hyperæmia of the aural meatus occurring in children, while the use of caustic solutions of nitrate of silver was followed by excellent results in cases of great hyperæmia of the tympanic cavity with interstitial or free exudation. Next in efficiency, the author praises resorcin in alcoholic solution and iodoform in cases of granulations. Rossi advocates the use of absolute alcohol to diminish profuse secretion, but expresses his doubts whether it has a determined action on granulations; in these cases he prefers the use of the solid nitrate of silver. The author classifies all conditions following hyperplastic middle-ear catarrh, chronic suppurations, and all trophic disturbances demonstrating any atrophic changes, under the heading, results of chronic inflammation of the middle ear.

Fifty-five of these cases are recorded, only eleven of which were improved.

Twelve cases of disease of the temporal bone following supuration of the middle ear, eleven in children and one in an adult, are recorded. The treatment consisted in removal of the diseased portions of bone with the chisel or sharp curette, and after-treatment with iodoform. Of these, four were cured, two improved, three not benefited, and four passed from observation.

Rossi, in speaking of the twenty-six cases of disease of the acoustic nerve, dwells upon the insufficiency of our present methods of examination. He places great diagnostic value upon the experiment published by Gruber in the *Monatsschr. f. Ohrenheilk.*, Bd. xix., No. 2, in cases of marked diminution of hearing power.

The following cases are described in detail in a supplement. Two cases of ankylosis of the hammer and anvil resulting from chronic middle-ear suppuration, in which disarticulation of the stapes from the anvil was followed by brilliant results. Several cases of caries of the petrous portion of the temporal bone caused by evacuation of the mastoid antrum, and the details of a case of caries complicated with an abscess at the angle of the jaw and other grave symptoms. In the last case recovery set in two and a half months after opening the mastoid process. The author further describes favorable results attending the use of jequirity in chronic suppurative inflammations of the middle ear, and adds a report of an autopsy upon a case of abscess of the peduncle of the cerebellum resulting from suppuration of the middle ear. S.

3. Eight hundred and twenty-five cases were treated during a period of two years in the aural clinic of the University of Würzburg. Furuncles of the external meatus were treated with warm compresses moistened with a two-per-cent. solution of acetate of alum. The author obtained good results in treating cases of acute catarrh of the middle ear, characterized by very viscid, stringy secretion, with diluted solutions of liq. natr. caustici (0.01-0.03 : 100 water). These were used two to three times daily in the form of instillations, syringing, and injections per tubam. The author recommends the use of bandage-cords of sublimate-gauze, already described on a former occasion, in cases of profuse otorrhœa. The description of a case of fracture of the handle of the hammer and rupture of the membrane is given in detail. A case of long-standing suppuration of the middle ear, which had been treated

by repeated curetting of the mastoid process, was cured by the expulsion in syringing of a large portion of the cochlea. Complete deafness existed. H.

4. June, 1883, an ambulatorium was opened in the general hospital of Copenhagen for the treatment of ear, nose, and throat diseases. The report covers the period up to the beginning of 1885. In all 406 patients, presenting 473 cases, were treated. One hundred and ninety-five were cases of ear disease, otitis media occurring often (69). There were 111 pharynx diseases, cases of adenoid vegetation being quite frequent (41). Diseases of the nose were represented by 82 cases. The laryngeal cases numbered 56. There were 5 cases of œsophageal disease, including 1 of simple stricture. Nineteen cases are not included in the above-mentioned classification. V. BREMER.

5. The total number of ear patients was 1,671. The number of operations was 59, among them being 15 Wilde's incision; 134 polypi removed; 2 sequestra from meatus.

SWAN M. BURNETT.

6. The total number of ear cases was 1,315. Among the operations were 6 polypi, 3 openings of the mastoid, and 2 tumors of the auricle.

SWAN M. BURNETT.

7. FERRERI, an assistant of the University Ear clinic of Rome, describes the methods of treatment practised there. As antisepsis should be the basis of every surgical procedure, he properly lays stress upon its adoption in the treatment of ear diseases, notably so in diseases of the tympanic cavity. He also draws attention to the necessity of a thorough disinfection of all instruments used in examination and operation, so as to prevent any possible infection, as still occurs. In general, the mode of treatment adopted does not differ from that in use in Germany. The author is an advocate of warm irrigations in chronic eczema of the auricle (in these cases it is mixed with a solution of sublimate and continued for two hours), in painful furuncles, in profuse dermatitis of the external meatus, and in myringitis.

The author employs iodoform in an etheric solution in chronic inflammation of the middle ear accompanied with purulent secretion, and to reduce granulations in the tympanic cavity of scrofulous children. When the secretion is more mucous in consistency, resorcin is used.

The first stage of sclerosis, called by the author, after Rossi, otitis media hyperplastica (proliferous infl.—Roosa), is treated with

solutions of caustic soda or iodide of potash injected per tubam into the middle ear. Adhesions or cicatricial membranes are treated with free incisions of the membrane, first of all, as a means to assist in a precise diagnosis, and secondly, as a preliminary step in the local treatment. The treatment with inflations of gaseous substances, as recommended by other observers, in these conditions has been discarded as useless. Injections of caustic remedies proving of no benefit in the more advanced stages, instillations of jequirity are used with the purpose of creating great congestion of the mucous membrane of the middle ear and favoring rapid absorption of the lymphoid exudation. The author has used the rarefactor of Delstanche with marked benefit in cases of pronounced retraction of the membrane accompanied with distressing tinnitus. He also advocates its use in cases of suppuration of Shrapnell's membrane, to remove through the usually small perforations, by suction, the accumulated secretion, which it would be difficult to remove by the air-douche.

8. Prof. BELL set forth the necessity and showed the possibility of deaf-mutes being taught to speak ; also, the importance of correcting our statistics in regard to the cause of deaf-mutism, alluding to the possibility of propagating deaf-mutism by the inter-marriage of congenital deaf-mutes. SWAN M. BURNETT.

9. The treatise of BARATOUX, comprising 132 pages, has been published in separate parts at various times in the *Revue mens. de Laryngol.*, etc. The author has conscientiously and critically collected the entire literature, both modern and old, on syphilis of the ear. The treatise also contains a number of personal observations. H.

10. ROOSA suggested that the term presbykusi be applied to the diminution of hearing due to the changes accompanying old age and which may be considered as physiological. These are manifested by a diminished bone-conduction and a confusion of hearing in noises. SWAN M. BURNETT.

11. ROUGIER describes two cases of necrosis accompanied by purulent secretion from the nose, the one due to syphilis, the other the result of a trauma. The symptoms, as given in the title and described in detail in the paper, were immediately relieved by the expulsion of the sequestrum in the one case, and complete recovery followed healing in the other. The author attributes the psychical disturbances to the irritation of the sensory nerves. H.

12. SETTERBLAD describes a case of rheumatic facial-paralysis, impaired hearing and great tinnitus, and lays special stress upon the galvanic hyperæsthesia of the acoustic nerve, so frequently a concomitant. He praises the action of the constant current in these cases.

V. BREMER.

13. KIESSELBACH's studies on the origin of tinnitus aurium and the portions of the ear giving rise to it, lead to the following conclusions:

(1) Tinnitus is produced by a hyperæsthesia of the sound perceiving apparatus. In some, this condition is a constant feature, in others but transitory, the result of a sudden change in the intralabyrinthian pressure.

(2) The hyperæsthesia itself cannot produce any sound impression, but gives rise to the possibility of hearing the blood noise constantly present (principally due to the increased resonance sound of the cavities of the middle ear) in an exaggerated degree. In normal conditions, this blood noise or resonance sound is not perceived as a result of irritation.

(3) It is possible, that an increase of the blood noise or a heightened irritability of the terminal acoustic filaments, in itself may suffice to render the tinnitus perceptible. In the majority of cases, both factors, however, come into play. In speaking of the treatment, Kiesselbach considers the protection of the patient from the cause of the hyperæsthesia, such as noises and music, of primary importance. Spontaneous tinnitus, the result of tubal catarrh, is treated with bougies, and faradization of the tubal muscles. Those cases of tinnitus directly due to the prolonged action of noises or mechanical insults are best treated with injections of pilocarpin, and abstracting blood from the vicinity of the ear. Lucæ's treatment with tones is indicated only in older cases, the author not favoring its use in recent cases. S.

14. TURNBULL describes the clinical features of five cases of tinnitus aurium. One case of objective tinnitus is of special interest, as being due to spastic contractions of the muscles of the Eustachian tube. A simultaneous contraction of the velum palati was noticeable with the aural tinnitus. The application of the constant current produced a recovery. H.

15. LONGHI observed, on examining a woman who was suffering from a chronic, dry, middle-ear catarrh on both sides, that the tuning-fork was heard distinctly at a distance of 25 to 15 *cm*, but was not perceived at 10 to 15 *cm*. At a distance of 10 *cm* it was

again plainly heard, and so close up to the ear. The author compares this condition with that defect occurring in vision, and calls it *scotoma auditivum*. He does not treat of it in the sense of a special disease, but regards it a result either of an unequal tension of various portions of the tympanic membrane, or this combined with some disturbances of auditory accommodation. S.

16. BAUMGARTEN noticed that the transfer of sound in the experiment of Rinne with the tuning-fork, from the ear tested to the other ear, in the great majority of cases occurs only when the tuning-fork is placed vertical on the mastoid process, and, as a rule, only in those tuning-forks that produce a large number of vibrations. Experiments have shown that that portion of the mastoid usually selected in opening the antrum is the best point to apply the tuning-fork. The author confirms the experiment that the sound of a tuning-fork placed vertical upon the mastoid process of a person with normal hearing power will be transferred to the opposite ear, the latter having been plugged with cotton. On closing the opposite ear firmly with the finger the sound will be heard still more distinctly, even if the ear corresponding to the point of application of the tuning-fork has been plugged with cotton. As soon, however, as this ear is also closed with the finger the sound transference ceases. On plugging the ear with cotton only, the transfer of sound is best studied on changing the parallel position of the tuning-fork to a vertical one in applying it. The ear being closed with the finger the oblique position of the applied tuning-fork will already produce a sound transference. Upon the presence of an impediment to sound conduction in one meatus, the tuning-fork applied to the vertex of the skull will be heard best on the same side; this, however, cannot exclude with any certainty a co-existing middle-ear affection. If, in such a case, the tuning-fork, placed on the mastoid of the sound side, is perceived on the affected side, but again transferred to the other side upon plugging the corresponding sound ear with the finger, the possibility of any co-existing middle-ear affection can be excluded with certainty. If, on the contrary, the sound is not perceived in the ear, the seat of the sound-conducting impediment, any middle-ear complication can be excluded *a priori*, as the tuning-fork applied to the vertex will not be heard better in either ear, thereby indicating the limited effect of the impediment. In disease of the middle ear, the sound of the tuning-fork placed on the mastoid of the opposite side, may be transferred or not. In case

the sound was perceived on the affected side, and then was transferred to the sound side upon plugging the ear of this side with the finger, the author considers the prognosis of the disease favorable. If, under these circumstances, the sound is still transferred to the affected side, notwithstanding the plugging of the sound ear, prognosis is unfavorable. Even if improvement take place, return to the normal condition is out of question. The degree of the prognosis of each individual case is also dependent upon the time, expressed in number of seconds, in which the tuning-fork, placed vertical upon the mastoid process of the sound ear, is still heard in the affected ear after it is no longer perceived on this side through air-conduction. If, in case of bilateral ear affection, the sound of the tuning-fork is not transferred to either side, it is probable that the disease is in the same stage in both ears.

In treating of the diagnosis of labyrinthine disease, the author always found that in case the tuning-fork applied to the vertex is heard on the affected ear, and in Rinne's test, the fork placed on the mastoid process of the affected side, is perceived in the other ear, disease of the labyrinth was developing. However, if the tuning-fork placed upon the skull is perceived in the better ear, and in Rinne's test is also transferred to this side, the diagnosis of labyrinthine disease can be established with more certainty. S.

17. The publication of LUCÆ's has been thoroughly reviewed by TRUCKENBROD in the report of the otological section of the fifty-eighth Naturforscher Versammlung at Strasburg (*vide* ZEITSCH. F. OPR., vol. xv., p. 193).

18. KNAPP thinks that no one test of hearing is sufficient, and criticises Bezold for using whispered speech alone in his examinations. He thinks that the perception of noises is often impaired at the beginning of deafness, when speech is well heard. He would have the watch, whispered voice, and conversational voice all used, and the hearing faculty expressed in a uniform, systematic method, and suggests the following: All defects in hearing the watch or speech to be expressed in fractions of the normal hearing distance. For watches, this must be determined experimentally for each one. The normal hearing distance for his whispered speech he takes to be about 20'; for his ordinary speech, 60'; and offers the following symbols for recording the degrees of hearing power:

$h = \frac{3}{4}$  = normal audition for (his) watch.

$v = \frac{2}{8}$  = n. a. for whisper.



$v = \frac{60}{60} = n. a.$  for speech.

$v' = \frac{20}{\infty}$  } whisper or speech heard, but not understood—quantitative perception of sound.

$v = \frac{60}{\infty}$  }

$v 60' = 0$  = voice not heard at all.

H or AUD. = 0 = complete deafness for all sounds.

$h = \frac{c}{24}''$  = watch of 24 inches normal hearing distance on contact with the ear.

$h = \frac{pr}{24}''$  = watch when pressed on the ear.

$h = \frac{m}{24}''$  = watch heard when applied to mastoid.

$h = \frac{t}{24}''$  = watch heard on temple.

$h = \frac{d}{24}''$  = watch on teeth.

$h = \frac{gl}{24}''$  = watch on forehead.

$h = \frac{v}{24}''$  = watch on vertex.

$h = \frac{ub}{24}''$  = watch heard everywhere.

When used to denote absence of hearing, these symbols are used as follows :

$h \frac{c}{24}'' = 0$  means that the watch is not heard on contact.

$h \frac{ub}{24}'' = 0$  means that it is heard nowhere.

A committee, consisting of Drs. Knapp, Roosa, and Prout, was appointed to report on a uniform measure of hearing at the next meeting.

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19. In inflating according to Politzer, WEIL, imitating Loewenberg, suggests that the neck of the patient be observed and the air-bag be compressed at the moment the larynx is raised. In order to produce a modified air-pressure he does not compress both nostrils, but leaves one open.

S.

20. Induced by the publication of Lancereaux on infection of syphilis by means of a catheter, in the *Gaz. des Hôpitaux*, Feb. 23d, MÉNIÈRE describes his method of disinfecting catheters. He solely uses silver catheters, which are kept in a vessel filled with alcohol. Before using a catheter he exposes it for some moments to the heat of an alcohol flame. The alcohol within the catheter is thus set on fire, and the instrument radically cleaned ; it is then dipped in cold water. The catheter is then thoroughly cleaned with copper wire. Using this method, it is impossible (?) to produce any syphilitic infection, even using the catheters employed in the treatment of syphilitics. The author soaks the rubber bougies used in dilating the tube in alcohol, and keeps them in a bottle containing tincture of iodine. Every patient, suspected to be syphilitic, is treated with his own bougie.

S.

21. In January of this year LANCEREAUX discovered in a patient unmistakable symptoms of secondary syphilis. In seeking for the source of infection, the only point elicited was that a profuse epistaxis followed the introduction of a Eustachian catheter. Upon this the author based his conclusion that the catheter was the medium of infection. According to data, the first catheterization, the infectious one, took place in the middle of September. As the epistaxis followed a repetition thereof in November, indications would point to a pre-existing chancre in the interior of the nose. In December, three months after incubation, at the time of observation, the patient presented an exanthema. Although it is very doubtful whether the disease can be attributed to the source ascribed by the author, the importance of thoroughly disinfecting all catheters after use cannot be overestimated. S.

22. KELLER gives a full history of the therapeutic experiments and use of the peroxide of hydrogen. He used this agent in a sixteen-per-cent. solution in several cases of chronic middle-ear suppuration, but found it possessed no advantages over the ordinary methods of cleansing the ear. He found its use advantageous in cases of pus accumulations, which are difficult to get at and remove by syringing, as the  $H_2O_2$  coming in contact with the pus not only rendered it fluid, but the ozone, generated by the catalysis, disinfects parts not reached by the fluid itself.

S.

23. The author has not found the sulphate of cocaine of any value in relieving the pain of otitis media or externa. The hydrochlorate has been somewhat efficacious, but only in superficial congestion of the tissues. He has used brucine in several cases, however, with decided relief to the pain, and particularly in otitis externa, it apparently anæsthetizing the skin more promptly than the mucous membrane. He used it in five-per-cent solutions.

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24. The author reports that he has been able to subdue the pain of acute otitis media, when the *Mt* was intact, by instilling a four-per-cent. solution of cocaine into the meatus, and allowing it to remain in contact with the membrane for five minutes. The pain, he says, seldom returns after the first application.

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25. The writer, as the result of his experience, answers the question in the affirmative, and the point seemed to be sustained in the discussion of the paper.

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INSTRUMENTS AND APPARATUS.

26. K. BEERWALD. Ueber einen neuen Hörmesser. (On a new acoumeter.) *Arch. f. Ohrenheilk.*, Bd. xxiii., p. 141.

27. Dr. L. SUNE MOLIST. Nuovo apparecchio per l'insufflazione nelle trombe e nelle casse del timpano, mosso per mezzo di pedale. (A new apparatus, moved by a pedal, to inflate the E. tube and the drum cavity.) *Bolletino delle malattie dell' orecchio*, etc., 1886, No 2.

28. Dr. P. RADZIG, of Moscow, Russia. Ein einfaches Mittel die Brauchbarkeit der Fischbein-Bougies (für die Tuba) zu erhöhen. (How to render whalebone bougies pliable.) *Monatsschr. f. Ohrenheilk.*, 1886, No. 2.

29. M. J. MOLONY. The aural reservoir. *The Lancet*, 1886.

30. Dr. MOURE. Canule nasale et auriculaire. *Gaz. des Hôpît.*, 1886, No. 50.

31. Dr. ZIEM. Notiz über Conservirung der Rachen-und Kehlkopfspiegel. (How to prevent the tarnishing of laryngeal mirrors.) *Monatsschr. f. Ohrenh.*, 1886, No. 5.

32. Dr. L. KATZ, in Berlin. Ein Instrument zur Untersuchung der Nasenhöhle. (A nasal speculum.) *Berliner klin. Wochenschr.*, 1886, No. 9.

33. Dr. ANTONIO RANIERI. Di un nuovo rhinobyon. (A pneumatic nasal plug.) *Bolletino delle malattie dell' orecchio*, etc., 1886, No. 3.

26. The acoumeter described by BEERWALD consists of a series of bells from C to C<sup>4</sup>, and a movable hammer to strike them with. The foot of the apparatus can be drawn out like that of a music stand, and the height of the bells thereby adjusted to the level of the ear under examination. The hammer, like the bells, is made of steel, but has one side covered with cork. It is made movable in a slot and therefore can be brought opposite any bell of the series. It can also be made to revolve around its axis, so as to strike either with its bare face or with that lined with cork. A quadrant arranged at its side enables the operator to graduate the momentum of its fall. The bells are made so as to produce sounds of single tones only, without any overtones.

27. MOLIST publishes a description of a stationary apparatus constructed by Salles, his assistant, for the purpose of inflating the Eustachian tubes. The apparatus being worked by the foot,

one hand of the operator is left free, while the other is engaged in holding the catheter in place. S.

28. On account of their stiffness, whalebone bougies are apt to cause laceration of the mucous membrane of the Eustachian tubes. In order to render them soft and pliable, RADZIG recommends that they be immersed in a dilute solution of carbolic acid for two or three days before being used. S.

31. ZIEM suggests that laryngeal mirrors should be warmed again after having been cleansed, in order to remove by evaporation any water which may have penetrated between the glass and the setting. This precaution will prevent tarnishing of the mirrors. S.

32. KATZ has constructed an apparatus by the aid of which the tip of the nose can be kept raised so as to allow a more unobstructed view of the interior of the nose when examined by the aid of a speculum. Such an apparatus will appear superfluous to all those who use the Hartmann-Böcker nasal speculum. S.

33. RANIERI has constructed his rhinobyon for the purpose of plugging the nostril, and at the same time allowing the patient to breathe through it. It consists of a rubber tube of medium hardness and of the size and shape of a Bellocq's canula, and which is surrounded in its entire length by a rubber bag. This bag can be inflated by a second tube, which is of smaller calibre and considerably shorter than the main tube, and runs parallel with its anterior extremity. A valve provided at the posterior end of the small tube prevents the air inflated into the bag from escaping. The apparatus acts as a pneumatic tampon.

#### EXTERNAL EAR.

34. E. R. CORSON. A case of bilateral rudimentary pinna and absence of external auditory meatus. *N. Y. Med. Times*, May, 1886.

35. E. DYER. Fistula auris. *Trans. Am. Otol. Soc.*, 1885.

36. Dr. HESSLER. Cyste in der Ohrmuschel nach traumatischem Hämatom. *Arch. f. Ohrenheilk.*, Bd. xxiii., p. 143.

37. Dr. SANGER BROWN. Hæmatoma auris. Three cases treated by the conjoined use of massage, galvanism, and leeching. *Med. Record*, June 10, 1886.

38. Dr. MCKEOWN, in Belfast. Keeping perforations of the membrana tympani open. *The Lancet*, 1886, p. 691.

39. Dr. UCKERMANN. Stappelse, Udridning af Trommehinder. *Norsk Magazin f. Lægevid.*, Bd. xvi., p. 133.

40. Sir W. B. DALBY. The functions of the membrana tympani illustrated by disease. *Amer. Jour. Med. Sci.*, July, 1886.

41. Dr. C. MIOT. Tumeur du manche du marteau. (Tumor of the handle of the hammer.) *Revue mens.*, 1886, No. 3.

34. In a colored infant, three days old when seen, both pinnas were rudimentary. There was a small skin flap recognizable as the lobule, a mere wrinkling of the skin representing the auricle. A dimple in the skin marked the ordinary position of the meatus.

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35. The observation was made on a girl of fourteen years, affected since birth with an offensive discharge from the fistula. A probe could be passed 1 *cm*. The fistula was destroyed by the galvano-cautery.

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36. HESSLER had occasion to operate on a cyst of the right auricle which had been preceded by a suppurating traumatic hæmatoma. In consequence of an injury received in 1880, a "cystoid" swelling, the size of a hazel-nut, had formed in the hollow of the auricle, which, on being incised, discharged some thin, pale yellow pus. After this a new cyst formed, which, in the course of time, became painful. In 1882 an incision, 2 *cm* long, was made under chloroform which liberated a brownish, watery liquid free from fibrinous shreds. The cartilage was laid bare to the extent of one square *cm*, where it was yellowish white and showed an irregular rent. This portion was removed by means of scissors. The wound was plugged with tampons. Perfect healing.

In connection with this case Hessler discusses the origin of cysts of the auricle in general, and repeatedly attacks the theory of the reviewer, who maintains that cysts may form spontaneously and independently of any hæmatoma. (See Germ. Edit., vol. xv., p. 133.) He considers the formation of a cyst to be invariably the result of some traumatism which causes slight hemorrhage between the cartilage and the perichondrium, and an inflammatory state of the latter, with the production of subperichondrial bloody serum. This view is doubtlessly correct as far as Hessler's own case is concerned, which ought rather to be regarded as one of abscess, but it does not apply at all to the idiopathic formation of cysts without traumatism and without inflammatory symptoms, as described by the reviewer. Not having any original observa-

tions of his own to offer, Hessler distorts the observations of others in order to make them serve his purpose. He maintains, for instance, that in the second case of Blake, which he has not even read in the original, there must have been an injury followed by hemorrhage. Now Blake made an incision into the swelling on the very day it had first made its appearance, and the liquid evacuated was transparent serum. There was no history of violence, and the case was evidently one of idiopathic cyst.<sup>1</sup>

37. Two of the cases were puerperal mania, and the other acute mania. Galvanism was used twice a day and massage four to six times daily.  
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38. McKEOWN describes a new method for establishing permanent artificial perforations of the membrana tympani, similar to one that has been proposed by Von Troeltsch. He forms a triangular flap with the base downwards. The free apex of such a flap will fall downwards and become agglutinated to the lower portion of the drum membrane by means of extravasated blood, etc. Such an opening will remain patent for weeks or even months. The author has carried out this method in order to verify his diagnosis in cases of affection of the middle ear, but mostly for the purpose of dealing directly with hypertrophic changes of the lining membrane of the tympanum. The majority of the cases so treated showed more or less improvement, a few remained stationary, and none became worse. S.

39. UCKERMANN reports three cases of relaxation of the drum membrane in consequence of misuse of Politzer's method. They were treated by galvano-caustic puncture. The patients were children of from five to ten years and suffered also from adenoid vegetations of the naso-pharyngeal space. V. BREMER.

40. From clinical observations which have been carried out with considerable care the author concludes: (1) That structural changes, particularly calcareous deposits, in the tympanic membrane of a very extensive nature may exist without impaired hearing. (2) Loss of continuity in the tympanic membrane does not necessarily interfere with its function, provided that the ligamentous support which it affords to the chain of ossicles is not impaired.  
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<sup>1</sup> Hessler as well as Blau (see *Arch. f. Ohrenh.*, Bd. xxiii., p. 185) regrets that I omitted to mention a case that had been reported by the latter author. I regard this case to have been one of perichondritis, perhaps also of hæmatoma, but by no means one of idiopathic cyst with absence of inflammatory symptoms, and for this reason I did not include it in my list.  
HARTMANN.

41. MIOT found a tumor consisting of three lobes firmly attached to the upper part of the manubrium mallei in a female patient who had become hard of hearing in consequence of purulent otitis media. It felt hard when touched with a probe, and was tender. Other methods failing to relieve the impairment of hearing, the tumor was removed by a knife curved on the flat, the operation being followed by considerable improvement in the power of hearing. Baratoux, who made a microscopical examination of the growth, found the cortical portion to consist of concentric layers of connective tissue and containing cells, while the central portion was composed of embryonic cells provided with large nuclei, which were disposed in very loose connective tissue.

#### THE MIDDLE EAR.

42. C. N. DIXON JONES. Acute suppurative inflammation of the middle ear; septic meningitis; pyæmia; marked pyrexia; death in eight days. *N. Y. Med. Record*, June 12, 1886.

43. G. BACON. A case of acute otitis media suppurativa, followed by mastoid disease and pyæmia; mastoid operation; recovery. *Trans. Amer. Otol. Soc.*, 1885.

44. H. CHATELLIER. Otite moyenne suppurée droite. Polype du conduit. Carie du rocher. Éruption d'herpes dans le conduit et sur le pavillon. (Herpes of the external ear occurring during the course of suppuration of the middle ear, etc.) *Annales des maladies de l'oreille*, etc., 1886, No. 6.

45. DR. DUJARDIN, in Havre. Note sur le traitement de la suppuration de la caisse par des instillations de sublimé (four observations). (Sublimate in otorrhœa.) *Revue mens.*, 1886, No. 6.

46. DR. A. EITELBERG, of Vienna. Die Ohrpolypen und ihre Behandlung. (On aural polypi and their treatment.) *Centralbl. f. d. gesammte Therapie*, 1886.

47. DR. HESSLER. Casuistische Beiträge zur operativen Behandlung der Eiterungen im Warzenfortsatze. (The operative treatment of suppuration of the mastoid.) *Arch. f. Ohrenheilk.*, Bd. xxiii., p. 90.

48. A. CECCHERELLI, in Parma. Trepanazione della mastoide. (Trephining of the mastoid bone.) *La Riforma medica* (Naples), 1886, No. 4.

49. SIMEON SNELL. On the implication of the mastoid bone in ear disease. *The Lancet*, 1886, vol. i., No. 4.

50. Dr. VICTOR HORSLY. Suppuration in mastoid cells, with thrombosis of lateral sinus and septic embolism. *The Lancet*, 1886, p. 1068.

51. E. M. STEPANOW. Zur Frage über die Function der Cochlea. (On the function of the cochlea.) *Monatsschr. f. Ohrenh.*, 1886, No. 4.

52. O. D. POMEROY. A fatal case of suppurative otitis media, with abscess of the cerebellum, necrosis and caries of the petrous portion, and hyperostosis of the roof of the tympanum. *Trans. Amer. Otol. Soc.*, 1885.

53. C. J. KIPP. A case of fatal ear disease beginning as a circumscribed inflammation in the outer half of the external auditory canal. *Trans. Amer. Otol. Soc.*, 1885.

54. A. MATHEWSON. Diseases of the brain resulting from affections of the ear and the temporal bone. *N. Y. Med. Jour.*, June 12, 1886.

55. S. SEXTON. Two cases of neglected ear disease in infants resulting in death. *Trans. Amer. Otol. Soc.*, 1885.

56. S. SEXTON. Inflammation of the attic of the tympanum. *Trans. Amer. Otol. Soc.*, 1885.

57. Dr. STANISLAUS VON STEIN, of Moscow. Über die Massage der Gehörknöchelchen und die Stimmgabelcur der Gehörsempfindungen. (On massage of the ossicles of hearing and the tuning-fork treatment of tinnitus.) *Deutsche med. Wochenschr.*, 1886, No. 7.

58. Dr. P. MCBRIDE. The prognosis of chronic non-suppurative middle-ear affections. *Edinb. Med. Jour.*, May, 1886, p. 1006.

59. C. H. BURNETT. The relation between chronic otitis media catarrhalis and chronic rhinitis. *Trans. Amer. Otol. Soc.*, 1885.

42. The patient was a woman, thirty-three years of age, affected with furuncles over her body. She had been nursing a woman who died of septicæmia. SWAN M. BURNETT.

43. The patient was a man, twenty-three years of age, and the clinical history, which is given in full detail, is typical of such cases. The opening in the mastoid was made by a drill, and the cavity contained 3 ii of pus. SWAN M. BURNETT.

44. CHATELIER, in a case of chronic otitis media with polypi, twice saw herpes of the external auditory canal and the auricle,



caused by the employment of an alcoholic solution of boric acid. Under the persistent use of this solution and the additional employment of lunar caustic, the herpetic blebs became confluent and transformed into ulcers, which healed under mercurial ointment. H.

45. DUJARDIN recommends a solution of corrosive sublimate, of the strength of 1 to 500, to be injected through a tympanal tube, introduced by means of a Eustachian catheter, for the treatment of suppuration of the middle ear. Out of four cases reported he cured two, and in the other two he succeeded in considerably diminishing the amount of secretion. H.

46. There are no novel features in EITELBERG's paper on aural polypi and their treatment, but we commend it, nevertheless, as an exhaustive and meritorious essay, showing considerable research, and well illustrated by cases of the author's own practice. The histology of aural polypi, their etiology, location, diagnosis, history, differential diagnosis, prognosis, and treatment are discussed in separate chapters. H.

47. HESSLER continues his report of mastoid operations, which he began in vol. xxi. of the *Arch. f. Ohrenh.* There are several interesting details both as regards the histories of cases as well as the method of operating. S.

48. In a patient who had been afflicted with purulent inflammation of the middle ear for a long time, and had suffered from violent pain on that side for two months, CECCHERELLI opened the antrum by means of a chisel. Only a few drops of pus were found, but the pain ceased immediately, and the hearing power, which had declined considerably before the operation, was restored to the degree previously enjoyed by the patient. S.

49. SNELL refers to the fact that cases of mastoid disease have been observed without preceding or concomitant disease of the middle ear, but thinks that this will always remain exceptional. Out of seven cases, from his own practice, of mastoid disease in consequence of middle-ear trouble, four recovered after free drainage of the tympanum had been re-established by the removal of polypi from the auditory canal and the tympanic cavity. The remaining three cases recovered after Wilde's incision. In case he should have to open the mastoid by an operation, Snell proposes to use Dalby's drill with stop arrangement. Taking into consideration the variable situation of the antrum mastoideum, we cannot consider the stop arrangement as being of any advantage. S.

50. HORSLEY opened the right mastoid in a girl, æt. seventeen, whose ear had been discharging since she was three years old. Two weeks before the operation the ear of that side lost its power of hearing entirely, and the surrounding parts became inflamed. Wilde's incision was performed, which liberated a quantity of fetid pus. The fever increased, nevertheless, whereupon the author opened the posterior portions of the antrum by means of a gouge. The posterior wall of the auditory canal was chiselled away, and thereby the tympanic cavity and the interior of the mastoid process changed into a single open cavity. The mastoid process was full of fetid pus. In spite of careful disinfection and iodoform dressing, the temperature line on the day following the operation showed the characteristics of pyæmia. Three days later there was severe precordial distress and dyspnoea lasting for half an hour. The patient now complained of severe pain in the region of the lower angle of the left shoulder-blade, where the physical signs of pulmonary embolism could be made out. Patient improved under antipyrin, and, at the end of three months, drainage could be dispensed with. S.

51. STEPANOW had occasion to observe a patient from whose left ear a sequestrum had been removed, which represented the upper  $1\frac{1}{2}$  convolutions of the cochlea. On examining this ear with all the tones within the limits of perception, from the lowest to the highest, no tone-defect could be found. The hearing power for ordinary and whispered speech proved greater on the affected than on the sound side. The only anomalies that could be detected were a reversal of the result of Weber's experiment, and a shortening of the duration of the sound of a tuning-fork on bone-conduction. The author formulates the following conclusions :

(1) The destruction of the upper part of the cochlea does not involve the loss of perception of lower tones in man.

(2) This fact is sufficient to disprove Helmholtz' hypothesis, since there is no positive proof for it.

(3) The loss of the upper part of the cochlea does not produce tone-defects.

(4) It has no influence, at least no qualitative influence, upon the perception of ordinary or whispered conversation.

(5) From the preceding deductions it does not follow that the cochlea has nothing at all to do with the perception of sound, the same as it does not follow that the semicircular canals and am-

pullæ have nothing to do with the perception of sound, because hearing may be preserved when there is congenital malformation or necrosis of these parts, or after they have been cut experimentally.

(6) At present we lack as yet a base on which to assign the perception of different kinds of sound (tones, noises, and speech) to different parts of the labyrinth.

52. The autopsy in this case revealed the anterior and upper third of the right lobe of the cerebellum to be more or less disorganized; the vermis superior normal, though soft; floor of fourth ventricle normal. The pia at the base showed opacity about the large vessels, and there was a moderate amount of fibrinous and purulent exudation below the right post. portion of the hemisphere; ventricles of the hemispheres much enlarged, and their floors smooth. No localized or diffuse pachymeningitis. The hyperostosis of the roof of the tympanum the author is inclined to regard as unique.

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53. The patient was a woman, aged twenty-eight. She had, at two different times, attacks of furunculosis on left side, from which she apparently recovered. Closely following the last attack, however, there was a great deal of pain deep-seated in the head. There was no tenderness or redness over the mastoid, nor was there evidence of any material tympanic inflammation. There was slight elevation of temperature. W. heard on contact, and t.-f. heard equally on both sides. She died, and a post-mortem examination showed evidence of intense inflammation over the entire extent of the arachnoid and pia-mater; an accumulation of pus in the ant. portion of the cerebellum; the left auditory and facial nerves embedded in pus; small abscess in anterior border of left cerebellar lobe; and the mastoid cells filled with purulent fluid; only slight evidences of tympanic inflammation.

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54. A general consideration of the whole subject is given, in which our existing knowledge of it is formulated, and six cases are given illustrative of the conditions. Case 1.—A man of forty, had scarlatina when a child; otorrhœa at times in right ear; pain on Jan. 1st over right mastoid; Wilde's incision; next day, brain complication, from which he died on the third day following. Autopsy showed caries of the roof of the tympanum, and an abscess of the brain over that part. Case 2.—A girl of eleven; otorrhœa with polypi in left ear, and an opening in the mastoid cells

from without ; facial paralysis. Under treatment, improved, and the mastoid fistula closed. In two months there was a return of pain and vomiting, drowsiness, constipation. Ophthalmoscope showed a slight neuritis. Died a few days after in convulsions. Autopsy : dura adherent over petrosus, and an ounce of pus in the cerebellum. Case 3.—A man forty years old ; otorrhœa of four years' standing, with polypi ; polypi removed ; exposure to cold ; cerebral symptoms followed by death. Case 4.—Woman, aged twenty-seven ; otorrhœa of several years ; fibrous granulations of tympanum ; pain and fetid discharge ; Wilde's incision, though no sign of mastoiditis, which revealed necrosis of the bone ; death. Autopsy showed an epitheliomatous growth springing from the petrosus. Case 5.—Boy, five and a half years ; acute otitis media ; right *Mt* not perforated ; child died, and caries of the roof of the tympanum was found, with extensive basilar meningitis. Case 6.—Girl of ten years ; otorrhœa ; polypi ; convulsions and pain ; death. No autopsy.

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55. Case 1.—Otitis med. pur. ; polypus ; facial paralysis ; pachymeningitis ; death. No autopsy. Case 2.—Ot. med. pur. complicated with lymphadenoma of the neck, resulting in caries of the atrium, attic, antrum, tympanic and auditory plates ; facial paralysis ; purulent meningitis ; death. On post-mortem examination, the inner wall of the attic was found to be gone, leaving the hor. semicircular canal exposed ; the wall of the antrum and adjacent cellules were eaten away ; the auditory plate was denuded and nearly loosened ; and a sinus existed between the antrum and abscess beneath the periosteum ; the annulus and tympanic plate were roughened ; on the inner surface there was an extensive opening along the line of the petro-squamosal suture, through which the inflammation probably passed to the brain.

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56. A description of the space known as the attic of the tympanum, taken from Leidy and illustrated by three drawings, is given. An account of the chronic form is first considered, and afterward the acute form. The treatment is such as the author usually follows in inflammation of the middle ear, placing reliance largely on internal remedies. Pain is treated by aconite, belladonna, pulsatilla, gelseminum, and suppuration is treated by small doses of mercury and calx sulph. In the more serious cases, he opens the cavity through the memb. flaccida, and inserts a piece of cat-gut for drainage purposes.

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57. VON STEIN employed Lucaë's massage of the ossicles of hearing by means of the elastic pressure-probe in thirty cases with the following results: (1) In three cases the probe-massage exerted no influence whatever upon the hearing faculty or upon the tinnitus. (2) In one female patient a tinnitus of many years' standing subsided after one month's employment of the massage, the hearing power not showing any noticeable improvement. (3) In the majority of instances only a moderate improvement of the hearing power resulted, whispered conversation being heard at the distance of about one meter, but the troublesome tinnitus decreased or disappeared altogether. (4) In four cases the hearing power was completely restored, but the subjective sensations persisted. In these cases, where the percipient organs were probably affected, the author had recourse to the tuning-fork treatment which proved very efficient.

58. MCBRIDE warns physicians not to be too rash in forming an unfavorable opinion in cases of hardness of hearing where bone-conduction is impaired and where there is more or less constant tinnitus. He relates the case of a patient who had been suffering from intense tinnitus for one year, and who had had several attacks of vertigo. There was greatly diminished bone-conduction on that side on which the hearing power was less. In the course of treatment, which was directed toward the naso-pharyngeal catarrh, from which the patient also suffered, the guarded character which the author had given to his prognosis proved to have been superfluous, since with the improvement of the catarrh the hearing power, the bone-conduction, and all the other symptoms also improved. While treatment was in progress, patient had a relapse of the naso-pharyngeal trouble, during which the bone-conduction became worse again, but this time the author had no misgivings about the significance of this symptom. His hopeful view was verified by the final result. A female patient had an attack of inflammation of the throat followed by tinnitus in both ears of several weeks' duration, and vertigo. The hearing power for the watch was  $\frac{2}{3}$  on the right side, and  $\frac{9}{16}$  on the left. Bone-conduction was abolished on the left side, the tuning-fork being heard on the right side only. In this case also the patient recovered after a few weeks' treatment of the middle-ear trouble by the ordinary methods. At the conclusion of the treatment the hearing power of both ears was equal, and the sound of a tuning-fork applied to the glabella was perceived equally on

both sides. A third case reported by McBride illustrates the negative value of the tuning-fork test, and also the fact that where both diminution of hearing and tinnitus are present, these two symptoms are not always to be considered as dependent upon one and the same cause. A female patient had been suffering from tinnitus in her left ear for eighteen months. Her hearing distance for the watch on this side was  $\frac{13}{30}$ , and bone-conduction was considerably diminished. On the right side ærial as well as bone-conduction was normal. Inhalation of ammonium chloride and applications of iodine to the mastoid process completely restored the hearing power as well as the bone-conduction of the left side, but the tinnitus remained. It depended upon the anæmic condition of the patient, and was successfully combated by preparations of iron. S.

59. The author believes that chronic aural catarrh is much more frequently accompanied by and dependent upon chronic rhinitis, than pharyngeal trouble. There are two forms, the hypertrophic and atrophic, each with definite aural signs and symptoms. The tinnitus is much more annoying in the atrophic form. The local treatment in such cases is to be addressed to the nasal mucous membrane, astringents and cleansing for the hypertrophic form; cleansing and stimulant for the atrophic. No form of the silver nitrate is to be used in the hypertrophic form, but is of value as a stimulant, particularly in the form of a powder, in the atrophic form. SWAN M. BURNETT.

#### THE LABYRINTH.

60. KIRK DUNCANSON. Mumps as a cause of sudden deafness. *Edinb. Med. Journ.*, January, 1886.

61. Prof. KUNDRAT. Demonstration eines vollständig verknöcherten Labyrinthes. *Wiener med. Presse*, No. 17, 1886.

62. Dr. J. HABERMANN. Zur Kenntniss der Otitis interna. *Zeitschr. f. Heilkunde*, 1886, Heft 1.

60. KIRK DUNCANSON adds a new case to those recently published by others, of sudden deafness in consequence of a severe attack of mumps. Contrary to general experience, according to which the deafness acquired in this way remains unchanged, Duncan's case in the course of time showed a slight improvement. S.

61. KUNDRAT's specimen was taken from a man æt. thirty, who ten years before his death had met with an injury to his

skull, followed by purulent discharge from his right ear. Head-ache and vertigo came on later and he became totally deaf on the right side. The autopsy revealed an old encysted abscess of the right cerebellar hemisphere extending on one side as far as the external auditory canal. The right temporal bone was much coarser in shape than the left, the edges having become rounded. On section of the petrous portion osseous obliteration of the labyrinth was found. H.

62. HABERMANN's minutely described case of secondary sup-puration of the labyrinth by propagation from the brain is a welcome addition to a number of analogous cases hitherto published by others. He had occasion to make the post-mortem examination of a boy who had become deaf in the course of meningitis, from which disease he subsequently died. According to the author's view the inflammatory agent which caused the meningitis had proceeded from the subarachnoidal space through the lamina cribosa and the aquæductus cochleæ into the perilymphathic space of the labyrinth. S.

#### THE NOSE AND NASO-PHARYNX.

63. Dr. ZIEM, of Danzig. Ueber die Ursachen der Anschwellungen der Nasenschleimhaut. (On the cause of the turgescence of the nasal mucous membrane.) *Allgem. med. Centralzeitung*, Nos. 16 and 17, 1886.

64. Dr. ZIEM, of Danzig. Ueber Bedeutung und Behandlung der Naseneiterungen. (On the significance and treatment of suppurative rhinitis.) *Monatsschr. f. Ohrenh.*, Nos. 2, 3, and 4, 1886.

65. Dr. J. F. NEUMANN. Ueber die Anwendung der Chromsäure und der Galvanocaustik in der Nase und in dem Rachen. (On the employment of chromic acid and the galvano-cautery in the nose and pharynx.) *St. Petersburger med. Wochenschr.*, No. 3, 1886.

66. Dr. ZIEM, of Danzig. Ueber das Zusammentreffen von Trachom der Bindehaut mit Catarrhen der Nasenschleimhaut. (On the connection between trachoma of the conjunctiva and catarrh of the nose.) *Allg. med. Central-Zeitung*, No. 23, 1886.

67. Dr. T. BOBONE, in San Remo. Un caso di spasmo sternutatorio. (A case of spasmodic sneezing.) *Bollettino delle malattie dell' orecchio*, etc., No. 4, 1886.

68. Prof. HACK, of Freiburg i. B. Zur operativen Therapie

der Basedow'schen Krankheit. (On the operative treatment of Graves' disease.) *Deutsche med. Wochenschr.*, No. 25, 1886.

69. Dr. E. BAUMGARTEN, of Budapest. Die Epistaxis und ihre Behandlung vom rhino-chirurgischen Standpunkte. (The treatment of epistaxis.) Vienna, 1886. Toeplitz und Deuticke.

70. Dr. SCHMIEGELOW. Om Stendannelse i Näseshulen. (On rhinoliths.) *Nord. med. Arkiv*, Bd. xvi., No. 16.

71. W. HUBERT, in Heidelberg. Ueber die Verkrümmung der Nasenscheidewand und deren Behandlung. (On the treatment of deviations of the nasal septum.) *Münchener med. Wochenschr.*, Nos. 18, 19, and 20, 1886.

72. Prof. COZZOLINO. Deviazione del setto nasale, delle ossa e cartilaggini nasali. (Deviation of the nasal septum.) *Il Morgagni*, 1886, fasc. 3.

73. Prof. COZZOLINO. Il lupus primitivo della mucosa nasale. (On primary lupus of the nasal mucous membrane.) *Archivi italiani di laringologia*, 1886.

74. Prof. COZZOLINO. Catarro faringo-nasale artritico. (Gouty catarrh of the naso-pharynx.) *Bollettino delle malattie dell' orecchio*, No. 4, 1886.

75. Dr. M. BROICH, of Hanover. Ein kurzer casuistischer Beitrag zu Tornwaldt's Beobachtungen über Erkrankung der Bursa pharyngea. (On disease of the pharyngeal bursa.) *Monatsschr. f. Ohrenheilk.*, Nos. 5, 6, and 7, 1886.

76. Dr. KEIMER. Casuistische Mittheilungen über die Erkrankungen der Bursa pharyngea. (On disease of the pharyngeal bursa.) *Monatsschr. f. Ohrenheilk.*, Nos. 3 and 4, 1886.

77. Dr. J. GOTTSTEIN. Zur Operation der adenoiden Vegetationen im Nasenrachenraum. *Berliner klin. Wochenschr.*, No. 2, 1886.

78. Dr. B. LOEWENBERG. Ueber Exstirpation der adenoiden Wucherungen im Nasenrachenraume nebst Beschreibung eines neuen Instrumentes zu dieser Operation. (A new instrument for the extirpation of adenoid vegetations of the pharynx.) *Deutsche med. Wochenschr.*, No. 16, 1886.

79. Dr. H. CHATELLIER. De quelques accidents qui accompagnent les tumeurs adenoïdes du pharynx. (On certain symptoms accompanying adenoid vegetations.) *Annales des maladies de l'oreille*, etc., No. 1, 1886.



80. Prof. GRANCHER. Un nouveau signe des tumeurs adenoïdes du pharynx nasal. (A new symptom of adenoid vegetations.) *Annales des maladies de l'oreille*, etc., No. 5, 1886.

81. Dr. LICHTWITZ. Des troubles de la voix articulée dans les affections du voile du palais, de la cavité naso-pharyngienne et des fosses nasales. (Disturbances of articulation in affections of the palate, etc.) *Revue mens.*, No. 4, 1886.

82. M. KIRMISSON. Tumeur neoplastique des fosses nasales. (Tumor of the nasal cavity.) *Gaz. des Hôpit.*, No. 3, 1886.

83. M. TILLAUX. Fibromyxome du pharynx nasal. Extirpation par la voie palatine. (Extirpation of a nasal tumor through the palate.) *Gaz. des Hôpit.*, No. 2, 1886.

84. M. CHURCHILL. Post-nasal fibroma in a child. *The Lancet*, Vol. 1, No. 4, 1886.

85. Dr. CAPART, of Brussels. Polypes fibreux naso-pharyngiens. Guérison par l'électrolyse. (Fibrous polypi of the naso-pharynx cured by electrolysis.) *Communications faites à l'académie*, 29 mai, 1886.

63. ZIEM points out that where there is persistent obstructive tumefaction and suppuration of the lining membrane of the nose, not dependent upon an affection of the hard structures of the septum, or of one of the conchæ, a focus of suppuration ought to be looked for in one of the accessory cavities of the nose. If this focus then be eliminated by appropriate measures, the obstruction and suppuration of the nasal fossa proper will remedy itself.

The turgescence of the erectile tissue of the nose dependent upon the presence of hypertrophied tonsils, or of tumors or vegetations of the naso-pharyngeal space, cannot be properly explained by nervous reflex, but only by venous congestion in consequence of impaired respiration. Cysts may form an exception, as the tension of the liquid contained in them may cause erection of the cavernous tissue by reflex irritation.

Enlarged tonsils or naso-pharyngeal vegetations, by impeding the movements of the pharyngeal muscles, and those of the palate, may retard the discharge of the contents of the posterior nasal veins into the pharyngeal and palatine veins, and thus act as local obstructions to circulation.

S.

64. ZIEM penetrated the maxillary cavity through the alveolar process 37 times in 23 persons suffering from chronic suppurative rhinitis, acting on the supposition that the rhinitis was

dependent upon disease of the mucous lining of the antrum, and actually encountered pus there 29 times, *i. e.* in 78 per cent. of the instances. From these observations he draws the conclusion that if more attention were paid to the maxillary cavity in chronic suppurative rhinitis, better results would follow.—According to Ziem, the sources of chronic suppurative rhinitis are the following: (1) Local inflammation of the mucous membrane of the nose. (2) Possibly also a general affection of this membrane. (3) Disease of the mucous membrane of the accessory cavities of the nose. (4) Disease of the bony structures of the nose and accessory cavities. (5) Affections of the teeth. All these sources may act either singly or in combination. The clinical symptoms of disease of the accessory cavities, as given by the text-books, are of little value. This must be said especially of the symptoms alleged to be present in disease of the maxillary cavities, such as tumefaction of the corresponding half of the superior maxillary bone, increased discharge of pus when the patient is lying on the opposite side, and pain and swelling of the cheek of the affected side. The first symptom, that of tumefaction of the bone, Ziem never saw in a single instance. In two of his cases there was no increased flow of pus when the patient was lying on the opposite side. Pain was present in two instances only, and swelling of the cheek in only one case of those operated upon by Ziem. A considerable quantity of pus may be present without producing a single one of the symptoms just enumerated. S.

65. NEUMANN melts chromic acid in a small spoon which is set at an angle to its handle. He brushes the parts with a five-per-cent. solution of cocaine before employing the acid, and afterwards with a solution of soda. The patient is made to drink soda- or Seltzer-water both before and after the operation. He has never observed vomiting.

66. ZIEM, in contradicting Scheff's assertion that nasal disease may be the consequence of ocular trouble, quotes Stoerck and Horner as authorities who hardly ever saw the affections of the conjunctiva extended to the nasal mucous membrane.

67. BOBONE had occasion to observe sternutatory spasm in the case of a girl eight years old, which was so violent, that on two occasions it threatened the life of the little sufferer. The spasm made its appearance in the latter stage of an attack of pneumonia. The sneezing spells, which first came on at long intervals only,

soon began to follow each other in rapid succession, so as not to leave the patient time to complete her inspirations. Lachrymation and profuse watery discharge from the nostrils were concomitant symptoms. The girl finally became cyanosed, and fainted from exhaustion. The spasm now subsided, and regular respiration was resumed. Soon, however, the sneezing spells reappeared, at rarer intervals at first, but gradually becoming more violent again, and in the evening of the same day she had another fainting fit. Bobone ordered repeated applications of a ten-per-cent. solution of cocaine, whereupon the sneezing spells began to subside, and there was no more fainting fit. On inspection of the nasal cavity, the entire tract of the lining mucous membrane proved to be highly congested. The covering of the lower turbinated bones was so much swollen as to touch the septum on either side. S.

68. The lady whom HACK cured of Graves' disease had from early childhood been suffering from marked bilateral exophthalmos, as well as from a tendency of her nostrils to become obstructed, and later on also from palpitations of the heart and swelling of the thyroid gland. On examining the nose, Hack found marked hyperplasia of the erectile tissue of the middle and lower turbinated bones. After cauterization of the erectile body of the right lower turbinated bone, the exophthalmos of that side was found the next day to have almost completely disappeared, and the same effect was produced on the other side by cauterizing the left lower turbinated erectile structure. In the course of time the palpitations also ceased, and the area of cardiac dulness became reduced to normal limits. H.

69. BAUMGARTEN's monograph contains a general review of old and new theories and observations concerning epistaxis. Its causes, prevalence, and treatment are accurately discussed, and the author's personal observations, which, however, do not seem to have been very numerous, are used as appropriate illustrations. Baumgarten uses strips of iodoform-gauze for plugging purposes. Only the actual or the galvano-cautery are considered as adequate means for destroying the bleeding points which are the sources of epistaxis. H.

70. SCHMIEGELOW relates the history of a man, æt. fifty-eight, who had been annoyed for sixteen years by the presence of a large rhinolith in his left nostril. He was cured by lithotripsy. The symptoms had been a sensation of fulness, a profuse, fetid discharge from the nostril, and one-sided perspiration of the

head, the latter symptom being considered as a reflex neurosis by the author. The concretion consisted mainly of the phosphates of calcium and magnesium. A general review of the subject is added.

71. In treating of the several methods that have been proposed for straightening deviated nasal septa, HUBERT points out that these deviations are of varying shape and degree, and that in some cases an orthopedic treatment will be found appropriate, whilst in others operative interference will be indicated. The author describes two new methods employed by Jurasz. One of these consists in the removal of the projecting portion of the septum by means of the galvano-cautery [this has already been proposed before by Voltolini—H.], and the other in the introduction, daily repeated, of cotton plugs into the obstructed nostril. The latter method is indicated especially in recent cases of deviation of traumatic origin. H.

72. COZZOLINO has employed the instrument devised by Jurasz for straightening deviated septa in eight cases, and in each with satisfactory results. In order to maintain the corrected position of the septum, the author employed Adams' plugs, only substituting rubber for ivory. He considers the substituted material to be less irritating to the nasal mucous membrane. In almost all of his cases from two to three days proved a sufficient length of time for the plugs to be left in to insure permanency of the correction. S.

73. Within the course of eight months COZZOLINO observed five cases of primary lupus of the nasal mucous membrane. As regards the etiology, diagnosis, and treatment of this affection, he has formed the following views: There is doubtlessly a form of lupus primarily attacking the nasal mucous membrane, principally that portion covering the cartilaginous septum. Primary lupus of the nasal mucous membrane is more frequent than lupus of any other mucous membrane. It may be mistaken for late or hereditary syphilis, especially if perforation or total destruction of the cartilaginous septum has taken place. Lupus of the mucous membrane has marked characteristics, and after once seen, can never afterwards be mistaken for any thing else. The only rational treatment for it is the same as that employed for lupus of the skin, namely, the local one. The nodules ought to be destroyed by the galvano-cautery, and the nasal passages properly cleansed and disinfected. Any other kind of treatment will prove

useless, and will not prevent the extension of the morbid process, which has a tendency to spread rather on the surface than to penetrate the deeper tissues. Every dermatologist ought to consider it his duty to examine the mucous membrane of the upper air passages in every case of lupus of the face, and especially of that of the integument of the nose. If this were done, primary lupus of the nasal mucous membrane will cease to be considered such a rare affection as it has been hitherto. S.

74. On the strength of two observations of naso-pharyngeal catarrh in gouty subjects, with abundant production of scabs of leathery consistence, COZZOLINO has come to the conclusion that the existence of the gouty form as a distinct variety of naso-pharyngeal catarrh is well established. The existence of such a form has been maintained by French authors generally. Besides these Cozzolino also quotes Mackenzie as an authority in favor of this view, but in this he is mistaken. Mackenzie mentions the fact that a connection between the gouty diathesis and catarrh of the naso-pharynx has been assumed by a certain English and an American author, but he himself considers the existence of such a connection as improbable. S.

75. BROICH succeeded in 20 p. c. of all cases of disease of the pharynx or of the naso-pharynx that came under his observation, to trace the cause to a catarrh of the pharyngeal bursa, but he has never been able as yet to detect a cyst in that locality. The eight cases which are published by Broich with full details, tend to prove that disease of the pharyngeal bursa as described by Tornwaldt is not a rare affection, and that this affection is capable of producing very serious discomfort. The employment of posterior rhinoscopy with the aid of Voltolini's palate hook rendered the diagnosis easy. The treatment was followed by good results in almost every case. In opposition to the opinion recently enunciated by Keimer, Broich thinks that bursitis pharyngea does not originate spontaneously, but is the consequence of acute or chronic nasal or naso-pharyngeal affections. S.

76. KEIMER publishes eight observations tending to corroborate the picture drawn by Tornwaldt of affection of the bursa pharyngea, and in which he relieved the patients by means of the treatment advised by the latter author. Regarding affections of the nose as associated with bursitis pharyngea, Keimer differs from Tornwaldt in not regarding them as secondary to the affection of the bursa. After the symptoms caused by the latter affec-

tion had been cured, he found that the nasal trouble still remained behind, and that he had to treat it separately in order to get rid of it. From this circumstance he draws the conclusion, contrary to Tornwaldt's theory, that the changes in the nasal mucous membrane are not the consequence, but the cause of the affection of the bursa.

Keimer also relates one case which presented all the symptoms of bursitis pharyngea, but where there was no bursa present. The continued formation of "oyster shells" in the usual situation of the bursa depended on chronic rhinitis. The presence of "oyster shells" alone will therefore not appear to be sufficient evidence of the existence of a bursa; the diagnosis can be established safely by means of a probe only. S.

77. GOTTSTEIN publishes the description of an instrument for the removal of adenoid vegetations of the naso-pharynx. It is somewhat similar to the fenestrated curette devised by Lange, but differs from it mainly in that the cutting part is made to work in a frontal instead of in a sagittal plane.

78. The fenestra of LÖWENBERG's curette is covered by a movable guard, which is to be withdrawn only after the instrument has been brought in opposition to the parts intended to be attacked. The object of the guard is to protect the sound parts from unintentional injury.

79. The concomitant symptoms of adenoid vegetations are the following, according to CHATELLIER: (1) Inflammation. He has found more or less distinct traces of inflammation in every case observed by him. (2) Pharyngitis under the form of pharyngitis granulosa. (3) Deformities of the nose. (4) Deformities of the chest. The disappearance of all of these symptoms after removal of the vegetations of the naso-pharynx proved that they had all been depended upon the presence of these growths. H.

80. GRANCHER draws attention to the difference in the mode of respiration in patients troubled with adenoid vegetations, according to whether they respire with their mouths open or closed. In the first instance the type of respiration is costo-diaphragmatic; in the latter, however, it is of the supero-costal type only, the supply of air is insufficient, and on auscultation the vesicular breathing will be found feeble and indistinct. H.

81. In the introduction to his paper LICHTWITZ discusses the physiological part played by the soft palate in articulation. He points out that not sufficient distinction is made between the

several kinds of disturbance of articulation caused by pathological processes affecting the parts concerned in articulation.

Following Kussmaul our author distinguishes *rhinolalia clausa*, which takes place when the nose and the naso-pharynx are shut off from the lower part of the pharynx, and *rhinolalia aperta*, which occurs when the communication between these parts remains open at those times when it ought to be closed. In *rhinolalia clausa* the passage of the sound waves is obstructed. Such an obstruction may exist with or without any narrowing of any of the cavities concerned in the production of articulate sounds. *Rhinolalia aperta* can be observed in cases of perforation, paralysis, or paresis of the palate, of œdema or infiltration, of mechanical impediments of mobility, and of congenital atrophy and consequent insufficiency of the velum. H.

82. KIRMISSON relates two cases in which malignant growths in the nasal passages were mistaken for simple polypi and treated accordingly. He points out the danger involved in such mistakes, and throws out a few hints concerning the differential diagnosis. There is also the report of a case of a tumor which had originated from the septum near the external orifice, and which was removed by means of the galvano-cautery. S.

83. TILLAUX relates an operation made for the removal of a tumor of the naso-pharynx which had grown from the posterior extremity of the lower part of the septum, and in which the velum had to be divided in order to gain access to the new growth. There was perfect recovery at the end of ten days, the cut wound of the palate having united at the end of the fifth day already. On microscopical examination the smaller or nasal portion of the tumor proved to be of myxomatous, the remainder or pharyngeal portion to be of fibromatous character. S.

84. CHURCHILL exhibited, before the Pathological Society of London, a fibroma which he had removed from the naso-pharyngeal space of a boy, eight years old. It had been attached by a pedicle to the upper surface of the velum, and had two finger-shaped projections which had extended almost to the nostrils. The tumor had been hanging down so as almost to reach the upper aperture of the larynx, and had evidently interfered with the proper development of the child. Microscopical examination showed a fine reticulum composed of narrow fibrous threads and some myxomatous tissue. The myxomatous character was more pronounced in the two projections mentioned before. S.

85. CAPART reports two cases of large fibrous polypi of the naso-pharyngeal space cured by electrolysis. In one case, fruitless attempts had been made to remove the tumor by Gussenbauer's operation, in which access is gained to the tumor by temporary resection of the hard palate and the velum. It was cured by electrolysis within two months. In the other case seven sittings proved sufficient to eliminate a large-sized tumor. The application of electrolysis is very simple, two electrodes being introduced into the new growth from in front, and a third from behind by the way of the mouth and the pharynx. As a rule, from four to six elements sufficed. The sittings were of from ten to twenty minutes' duration. H.



## Reviews.

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**Die Krankheiten der Nasenhöhlen, ihrer Nebenhöhlen und des Nasenrachenraumes mit Einschluss der Untersuchungstechnik.** Zum Gebrauche für Aerzte und Studierende. Von Dr. WILHELM MOLDENHAUER, Docenten an der Universität Leipzig. Leipzig : 1886. Verlag von F. C. W. Vogel.

**The Diseases of the Nasal Cavities, of the Accessory Cavities of the Nose, and of the Naso-Pharynx.** By Dr. WILHELM MOLDENHAUER. Reviewed by A. Hartmann, of Berlin.

In this book of 198 pages Moldenhauer has attempted to give a brief and succinct résumé of the pathology of the nasal cavities and the naso-pharynx, laying special stress upon a faithful reproduction of actual appearances. This task he has solved admirably, the style of the work being remarkable for clearness and precision, whilst theoretical speculations are carefully avoided. He shows himself to be an acute observer, and well qualified by extensive experience to give us a faithful picture of the diseases of the nose and the naso-pharynx, and of their treatment. Where the author's views differ from those generally held, there is ample justification for such difference.

The subject-matter is systematically divided into several chapters, which are preceded by an introductory essay on the anatomy and physiology of the parts. For the examination of the nose Moldenhauer recommends the Duplay-Charrière speculum. Zaufal's funnels he considers to be useful in exceptional cases only. In the chapter on general therapeutics the several methods of treatment are accurately described. He emphatically condemns the indiscriminating use of the nasal douche, which is the cause of so much mischief. In speaking of the operative correction of the deviated septum, he points out that this procedure is often rendered more difficult from the fact that the external aperture of the

nostril is placed at a higher level than the lower limit of the deviation. In order to gain better access under these conditions Moldenhauer incises the lower rim of the nostril, and extends the cut in the direction of the naso-labial fold.

In the treatment of acute coryza we miss the mention of cocaine, which not only relieves the distressing symptoms caused by obstruction of the passages, but also in many instances aborts the morbid process altogether. In treating of chronic fetid rhinitis the author insists that simple ozæna ought not to be brought in connection with chronic catarrh, and in this matter our own observations tend to bear out Moldenhauer's view. The supposition that *rhinitis atrophicans* is the final stage of chronic hypertrophic catarrh, is entirely arbitrary. Moldenhauer thinks that it would be more honest and at the same time more scientific to acknowledge that we know too little as yet of the etiology of fetid rhinitis.

The neoplasms of the nose and the adenoid vegetations of the naso-pharynx are minutely described in the following chapters, and the author's own conclusions, derived from an extensive practice, are well set forth. As regards the origin of reflex neuroses Moldenhauer adopts Hack's theory, that "the turgescence of the cavernous tissue of the lower turbinated bones, whether permanent or only transitory, plays an important part in the transmission of so-called secondary reflexes."

We have pointed out a few only of the most salient features of Moldenhauer's treatise, and have not given an adequate idea of the value of its contents. We recommend this book to everybody who is interested in the study of the diseases it treats of, and are convinced that beginners as well as experienced practitioners will read it with profit, and gain many valuable suggestions from its pages.

**Reference Hand-Book of the Medical Sciences.** New York : Wm. Wood & Co. Vol. II., 1886. (Sold only by subscription.)

In regard to this second volume, we can but reiterate what we said in commendation of the first. It is a work useful for the general physician and surgeon to have, on account of the value of the special articles, and equally of value to the specialist for the papers on the other branches of medicine outside his own. All the articles on otology in this volume are written by men whose names are well-known, and some of them are of peculiar excellence.

The first paper, on "Deaf-Mutes," by Prof. E. A. Fay, of the National Deaf-Mute College, is worthy of the most careful perusal. It is exhaustive in its statistical presentations, from every point of view, giving the extent of deaf-mutism, the causes—consanguinity of parents, maternal impressions, scrofula, social circumstances, mountainous regions, diseases and accidents,—mental condition and characteristics of the deaf-mute, morbidity, their mortality, etc., with a full account of the origin and growth of schools and methods, with a consideration of alphabets and visible speech. Prof. Gallaudet contributes an interesting and instructive appendix to this paper, on "The Language of Signs and the Combined System of Instructing Deaf-Mutes." "The Anatomy of the Labyrinth of the Ear" is treated of by Wm. G. Thompson, with ten fairly good illustrations. "The Development of the Ear" is given by C. W. Minot in his characteristic clear and exhaustive manner, with nineteen drawings. Huntington Richards explains the methods of examining the ear for diagnostic purposes. The "General Therapeutics of the Ear" is by the editor, Dr. Buck, discussing (1) measures for controlling pain, in which he condemns most heartily the mild measures adopted by some, believing in the heroic methods of abstraction of blood, paracentesis, and the hot douche; (2) measures for arresting a discharge from the ear, which consist in the well-known and generally employed remedies. "Non-Suppurative Inflammations of the Tympanum" are considered by D. B. St. J. Roosa. In the treatment of the chronic form the author laments, as we all do, the inefficiency of treatment. He relies but little on mere local treatment, having had better success with a change of climate. He thinks Georgia and North Carolina (and the reviewer would add, South Carolina) the best climates for such patients. "Purulent Inflammations of the Tympanum" is an exhaustive treatise of forty pages by J. Orne Green, a short abstract of which could not do justice to the original. Every otologist could read it with profit. A diagram is given of the brain sinuses and their connections, which is of great value in tracing the path of phlebitis of the emissary vein. "The Anatomy, Physiology, and Diseases of the Eustachian Tube" are treated of by Gorham Bacon.

S. M. B.

**Lectures on Clinical Otology, Delivered before the Senior Class of the Homœopathic Medical College.** By HENRY C. HOUGHTON, M.D. Boston: Otis Clapp & Son, 1885. Pp. xiv. + 260.

This book, being written for students, contains but little to interest the special practitioner, except as it records the experience of an intelligent and honest man. There is nothing new offered in the way of pathology; and its therapeutics, so far as concerns the internal administration of medicines, is strictly homœopathic; and there is a very extensive appendix, containing a summary of remedies which are believed to be valuable in the treatment of the various symptoms. The book is pleasantly written and well printed. The author manifests his appreciation of the work done in otology by Dr. Roosa by dedicating his work to him.

SWAN M. BURNETT.

**On the Importance of the Bursa Pharyngea in the Causation and Treatment of Certain Diseases of the Naso-Pharynx.** By Dr. G. H. TORNWALDT, Dantzig. Wiesbaden: J. F. Bergmann. 119 pages. Review by Dr. E. Schulte. Translated by J. A. Spalding, M.D., Portland, Maine.

Since Meyer's remarkable work on adenoid vegetations of the naso-pharyngeal space, some twelve years ago, Tornwaldt's treatise is the first to offer us genuine and serviceable material for the erection of a fundamental pathology of this region. And how much our therapeutics will gain from this book is easy to see, when we reflect that in the future our task in a number of naso-pharyngeal affections will not be simply to care for the individual symptoms, but to attack at once the demonstrated anatomical cause of the whole series, and to terminate them by means of a few manipulations, which can, of course, only be performed successfully by a well-trained hand.

The author was able to refer a large number of cases of naso-pharyngeal, or simply nasal, catarrh to pathological alterations in the bursa pharyngea, which was first described in 1842 by F. J. C. Maier. This structure he was able to render visible at any rhinoscopic examination by elevating the uvula with Voltolini's hook. In so doing, he always found in a line projected backward from the nasal septum, and about half way between the upper end of the septum and the anterior tubercle of the atlas, an opening in the mucous membrane, which, in its appearance and situation, corresponded precisely to the entrance of the bursa pharyngea as described by Luschka.

The opening and the sac (which varies, of course, in size in different persons) are so constant, that Tornwaldt considers their absence an abnormality.

The pathological alterations of the sac as at present observed consist in hypersecretion, with the production of a mucous or generally of a purulent secretion, the latter having rarely any offensive odor. Sometimes, however, the bursa is transformed into a cyst, as has already been described by Luschka, Troeltsch, and Czermak. This condition may be diagnosticated whenever a cyst is found in the middle line of the roof of the naso-pharynx, in the situation of the orifice of the bursa pharyngea, which itself in turn cannot be discovered.

The morbid symptoms which represent the natural sequences of the abnormal secretion or the formation of the cyst are, on the one hand, the disagreeable sensations which the affection produces at the precise location of the bursa, such as dryness, burning, the presence of some foreign body, pain in the pharynx, a frequent desire to swallow or to clear the throat, obstruction to nasal breathing, and a dissonant nasal voice. On the other hand, we have the accessory symptoms of morbid sensations in adjacent parts, such as alterations in the mucous membranes, diseases of the ears, granular pharyngitis, chronic laryngitis (the intra-arytenoid portion being chiefly affected), bronchial catarrh, catarrh of the stomach, coughing without any demonstrable disease of the lungs or larynx, bronchial asthma, breast pains in the region of the manubrium sterni, and headache in the back of the head and neck, or in the forehead.

The treatment which Tornwaldt employed for the relief of the hypersecretion consisted in careful removal of the secretion, insufflation of silver nitrate, tannin, or alum, with a patent condition of the orifice; but if this were constricted, silver probes tipped with silver nitrate were introduced, or solutions of the same were syringed in, or pure tincture of iodine was applied with a fine platinum canula. If success was not thus attained, the galvano-cautery was employed, one application generally sufficing to reduce the secretion for several days. Occasionally the cauterization had to be repeated several times before the bursa was entirely destroyed and the secretion totally removed, whilst in a few rare cases this method failed to relieve the symptoms permanently.

All cysts in the bursa were opened with a knife-shaped cautery, and if, despite this, the secretion continued, and could not otherwise be stopped, the sac was destroyed with the galvano-cautery.

The new facts communicated by the author are illustrated by twenty-five detailed cases, all of which testify in favor of Torn-

waldt's theory of the cauterization of many naso-pharyngeal diseases.

A careful reading of this treatise inclines us to express the wish and hope that in all cases of naso-pharyngeal catarrh the precise treatment advocated by the author may everywhere be sagaciously imitated. The time, then, will not be far when the expression "naso-pharyngeal catarrh" will have disappeared entirely from our terminology.

**Hand-Book of Otology, for Students and Physicians.**

By Dr. WILHELM KIRCHNER, Wuerzburg. With thirty-nine woodcuts. Published by F. Wreden, in "Wreden's Collection of Short Works for Medical Instruction." Reviewed by Dr. H. Steinbruegge, in Giessen. Translated by J. A. Spalding, M.D., Portland, Maine.

It is a well-known fact, that despite the inferior position into which the medical profession would gladly push otology, in comparison with the other preferred and more crowded specialties, yet practical physicians and medical students confess, with more or less publicity, that they would like to know more about the science of the ear, and the manner in which its diseases should be treated and the essential operations be performed. But the practitioner is burdened with his patients, and the student with apparently more important studies; the new specialty must not take up too much time or labor. Hence, in most cases, all that is necessary, in the eyes of the bold practitioner, is a course of a dozen hourly lectures and an india-rubber bag, to enable him to treat all diseases of the ear, or, at least, all that are acute in origin and course.

It sometimes seems as if we ought to put a stop to all these compendiums of otology. What is the use of continuing to hatch out new and ever-new broods of mere dilletanti in an art which demands, at the start, a fundamental knowledge of anatomy, then deep physiological investigations, and finally assiduous practice and frequent necessary manipulations for years, before any physician can become a virtuoso in this specialty.

If now we bid a sincere welcome to Kirchner's book, it is simply because the treatise contains a perfect compilation of all that is important in modern otology. Although there may be a trifle too much of operative technique for the beginner, this mere superfluity is highly to the advantage of those who are practised in the specialty of the ear. For this reason chiefly, we feel that the

author is entirely too modest, when, in the preface, he recommends his treatise to students and practitioners in medicine, whilst, in reality, even the most cultivated otologist cannot fail to find in these pages an extremely desirable recapitulation of all the remedies and operations that experience and practice have tried and proved, while, at the same time, all unnecessary ballast or padding has been thrown overboard. And one of the nicest qualities of the whole is that we can read its two hundred pages without meeting with offensive interruptions in the shape of long passages in fine print and frequent foot-notes.

A short introduction leads us to the first of the seven sections into which the book is divided, in which are described the examination of the ear and naso-pharyngeal space, the tests for hearing, the use of the air-douche and catheter ; later on, in sections, each beginning with a brief anatomical introduction, we are taught the pathology and treatment of the diseases of the ear, divided, according to the generally-accepted doctrines, into those of the external, middle, and internal ear. We must, however, at this place take occasion to state that we heartily agree with the author when, in his preface, he says that this subdivision is of no real value, except for the facility with which the various topics can be glided through, and that no such local distinctions really exist, for the very reason that the cavities of the so-called middle ear really extend into the districts supposed to belong to the external or internal ear. We might be tempted additionally to say that in morbid conditions the membranous and ossified walls which separate the anatomical subdivisions so artificially created, often give the disease a greater chance to spread than a means for cutting it short ; that the entire organ of hearing forms a physiological unit ; and, finally, that the morbid disturbances of nutrition which affect one portion of the organ will ultimately, at least to a certain degree, affect the rest by sympathy or extension.

Such reflections as these are frequent enough when we read over, in the numerous treatises of otology, the final chapters on otitis externa diffusa, on myringitis, on isolated affections of the tube, or, further still, when we attempt to follow the efforts, directed with so much skill and waste of time, to define the delicate distinctions which exist between the diseases of the so-called middle and inner ears, when in reality many of them may never be seen except in the rarest of cases. It is, therefore, appropriate to warn the beginner in otology of the imperfection of the anatomi-

cal subdivisions of the distance to which isolated diseases of various localities may extend, and to call his attention to the frequency of combinations in diseases of the organ of hearing.

The most comprehensive fifth section of Kirchner's text-book contains the diseases of the tympanum, the complications with affections of the mastoid process, meningitis, polypi, formation of cholesteatomata, and the tropho-neuroses. We see here, with pleasure, that the author has retained the old and simple, yet so practical, subdivisions, of the diseases of the tympanum, into the acute and chronic catarrh and acute and chronic suppuration of the tympanum. The treatment insisted upon is quite active and energetic; also in the acute cases, and is doubtless based on his own experience.

One of the most important things insisted upon is, that in acute affections of the ear the patient should be carefully attended and rested, and spared from any excitement. For many a physician have I seen stand amazed in ignorant astonishment when a patient with simple catarrh of the tympanum or a perforation of the membrana tympani has been urged to keep in the house, or even to go to bed. Too true it is, that this is the common idea of the neglectful way in which diseases of the noble organ of hearing may be treated.

The sixth section contains the diseases of the labyrinth, Ménière's complex of symptoms, and hysterical paralysis of the auditory nerve. The seventh treats of deaf-mutism, simulation of deafness, and of hearing-trumpets. The text is interspersed with thirty-nine excellent wood-cuts, partly anatomical, partly prefiguring instruments. The type and paper are excellent. The few errata will, of course, be corrected in a second edition. And thus, with great pleasure, we call the attention of our colleagues, and of the profession generally, to Kirchner's "*Hand-Book of Otology*," and hope that it may meet with extensive sale not only in Germany, but even in distant lands.

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## MISCELLANEOUS NOTES.

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U. PRITCHARD, of London, has been chosen to fill the newly established chair of otology at King's College, London,



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## In Memoriam.

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PROFESSOR DR. ALBERT BURCKHARDT-MERIAN,  
OF BASLE,

died after a long and painful illness, in consequence of endocarditis, before completing the forty-fourth year of his life.

In the deceased we have lost a colleague who was an excellent man in every sense. Being of a genial, open-hearted, and amiable disposition, he won the sympathy of everybody who came in contact with him, and never afterwards lost it. He was an ardent student and an efficient and conscientious practitioner. He did faithful work as author, teacher, and physician, and was much beloved by his patients as well as by his students. He not only was a diligent writer himself, but also stimulated his pupils to much valuable work. He was a warm-hearted colleague. Being always led by ideal aspirations, he did not allow himself to be restricted by the narrow limits of his specialty, but bore himself on every occasion as a champion of the interests of the whole medical profession.

In conjunction with Dr. Bader he founded and edited the highly esteemed *Zeitschrift Schweizer Aerzte*.

It was through his efforts that the regular meetings of South-German and Swiss Otologists were inaugurated and successfully kept up, and it was from his individuality that these meetings received the charming impress of harmony and sociability. Those who have hitherto taken part in these reunions will sadly miss him in the future.

The members of the Third International Otological Congress will remember with gratitude how diligently he labored for the successful organization of the Congress, and how much ability and tact he displayed as its presiding officer.

Moos.

HEIDELBERG, November, 1886.

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## ARCHIVES OF OTOTOLOGY.

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### CLINICAL OBSERVATIONS UPON THE DISEASES OF THE MASTOID PROCESS, WITH AN HISTORICAL SKETCH OF THE ORIGIN OF OPERATIONS UPON IT.\*

By D. B. ST. JOHN ROOSA, M.D.

THE object of the following paper is to present a picture of diseases of the mastoid process, as seen in the private and hospital practice of a specialist in New York. The notes of the cases occurring in my private practice have been rather carefully taken in most instances, and the record may be relied upon to give a fair idea of the frequency with which mastoid disease is seen in special practice, and also of the nature of such disease. These notes, however, fail to give an accurate idea of how many times the mastoid process is actually affected, in a given number of cases of diseases of the ear, taken just as they occur in a community.

Strange as it may seem to some, acute aural disease does not reach the specialists in any such proportion as do the chronic affections, especially of the non-suppurative variety. There are many reasons for this—for example: Many general surgeons, who would not meddle with a chronic disease of the ear, feel themselves entirely competent to manage an acute catarrh or acute suppuration with mastoid periostitis. Then, also, there yet lingers, even in the minds of many who are friendly to specialists, an idea that we are only of use when all the resources of the general practitioner are exhausted, that we have special principles of treatment which come in when general principles fail.

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\* Read before the Section on Ophthalmology and Otology in the New York Academy of Medicine, March 21, 1887.

We are also considered, in some quarters, in spite of our protests, as office practitioners merely, who decline to see cases serious enough to confine the patient to the room. Such reasons as these render the proportion of mastoid affections seen by a specialist smaller than would perhaps be generally supposed.

The hospitals and infirmaries give a more correct idea of the proportion of acute aural disease in general, and of mastoid disease in particular, for the poor have found out to a much larger extent than the well-to-do, that the best assistance in acute aural disease is to be found among those who give special attention to it. But we must take facts as they are, and I venture to present my rather commonplace statistics to the kindly consideration of this learned body. They may show something of what has come to me in this direction in the last twenty-two years.

I present the notes of 59 cases of affections of the mastoid process, in 5,797 cases of aural disease, which have occurred in my private practice in that time. Occasionally, I have omitted to record one which I have seen in consultation, but there are not many such, so that the record is tolerably exact.

I also present statistics of 33 cases observed in my practice at the Manhattan Eye and Ear Hospital in the last eighteen years. I am obliged to say that, until very recently, we have not had, in the press of work at that institution, the facilities for keeping full notes of all the cases, so that the record is very incomplete. The total number of cases that have been diagnosticated as affections of the mastoid, in all the aural departments of this institution for eighteen years is 110.

Here, also, there is a source of error, for some cases that entered the hospital, and were diagnosticated as simple catarrh or suppuration, finally became cases of mastoid disease. Besides this, many made but a few visits and never returned, so that we knew nothing in many instances of the ultimate results. At the close of the paper, will be found statistical tables in more or less detail of the total number of cases.

I have selected for your consideration this evening only the striking ones of which tolerably complete histories are given, and those which have not been heretofore published. Those which have been published already, are indicated, and the source where they may be found, given, so that the student who is interested in this part of literature may make this paper more complete by referring to them.

As a matter of historical justice to some American writers and surgeons, among whom I may venture to place myself, I have also added an historical sketch of the literature and work upon diseases of the mastoid process, for the last ninety years.

A summary of all the cases here reported shows as follows :

*Summary of Cases in Private Practice.*

No. of cases treated, males . . . . .	33	Result : Died . . . . .	9
" " " " females, . . . . .	26	Cured . . . . .	36
	59	Relieved . . . . .	10
	—	Unknown . . . . .	4
			59

The disease of the mastoid occurred in the following named affections :

Acute catarrhal inflammation of the middle ear . . . . .	11
Acute suppuration of the middle ear . . . . .	25
Chronic suppuration of the middle ear . . . . .	18
Primary mastoid periostitis . . . . .	1
Inflammation of the external auditory canal . . . . .	2
Exostosis of the mastoid . . . . .	1
Neuralgia of the middle ear . . . . .	1
	59

OPERATIONS.

Wilde's incision made with evacuation of pus . . . . .	9
Wilde's incision without pus . . . . .	11
Mastoid opened by enlarging fistula . . . . .	16
Opened without finding fistula . . . . .	4
Opened through external auditory canal . . . . .	2
	42

*Summary of Cases Treated in the Writer's Clinique at the Manhattan Eye and Ear Hospital.*

No. of cases treated . . . . .	33	Result : Cured . . . . .	14
		Relieved . . . . .	5
		Died . . . . .	1
		Unknown . . . . .	14
			33

DISEASE.		OPERATIONS.	
Acute catarrh of the middle ear .	2	Wilde's incision . . . . .	7
Sub-acute catarrh of the middle ear . . . . .	1	" " pus evacuated . . . . .	5
Acute suppuration, middle ear .	8	Opening mastoid with a drill . .	14
Acute suppuration of the middle ear, with mastoid fistula . .	1	Treated without operation . .	7
Sub-acute suppuration of the middle ear . . . . .	1		—
Chronic suppuration, middle ear, .	11		33
Chronic suppuration of the middle ear, with mastoid fistula .	4		
Chronic suppuration, middle ear, with polypus. . . . .	1		
Chronic catarrh of the middle ear, .	1		
Primary inflammation of the mastoid . . . . .	2		
Impacted cerumen with mastoid periostitis . . . . .	1		
	—		
	33		

First, the **cases in which death occurred.** There were ten of such cases in private practice and one in the hospital cases. One of the deaths was probably not induced by the aural disease; but the others are undoubtedly to be classified in this way:

*CASE 1.—Suppurative inflammation of the middle ear soon after birth; mastoid periostitis; incisions; death.*

Boy of three months of age, seen in consultation with Dr. M. W. Williams. There was an abundant discharge of pus from the tympanum. Considerable œdema of the mastoid, and evidences of meningitis. Dr. Williams had incised the tissues down to the bone before I saw the patient. I repeated this incision a few days after. No pus was found. Inasmuch as there was free drainage from the tympanum, no further operation was performed. The patient died in a few days afterward.

*CASE 2.—Suppuration of the middle ear for six years; death.*

Female, æt. fifty. Four years ago she had an attack of severe pain and swelling in the right ear from which she recovered, but a discharge remained. One year ago she had acute inflammation of the mastoid process. The integument and periosteum were incised, pus discharged for two months and then ceased. Two weeks ago the inflammation recurred in the same part. There was intense pain in the ear, and an offensive discharge from it; the latter continued. H D, R  $\frac{6}{36}$ , L  $\frac{c}{36}$ .

The patient has been living in a malarial district, and has taken largely of quinine.

The left auditory canal is narrowed and crooked and filled with pus. The drum-head is nearly gone, and there is caries of the tympanum, the mastoid cells, and posterior wall of the auditory canal. Dr. E. T. Ely saw the patient for me at first, and advised the application of six leeches and the hot douche every three hours. In a few days the patient was much better, the mastoid was not tender, but there was intense pain in the head and constant vertigo. The bones of the tympanum were gone, and the foramen ovale probably opened. I learned afterwards this patient died very soon after Dr. Ely and I saw her, which we did but a few times, when we were dismissed.

*CASE 3.—Acute suppuration of the middle ear; mastoid periostitis; meningitis; death.*

This case has already been published in full (*Medical Record*, July 7, 1877; also p. 310, author's treatise). It is simply necessary to say here the patient died of meningitis from acute suppuration of the middle ear, in twenty-eight days from the first attack of aural inflammation. Wilde's incision was made, but no disease of the bone was found, and the post-mortem examination showed that such an opening would have been in vain.

*CASE 4.—Chronic suppuration of right middle ear; mastoid swelling; abscess; opened with drill; died about three months after from meningitis.*

Male, æt. twenty. Under the writer's observation for about fourteen days.

The patient has had a discharge from his right eye ever since infancy. The drum-head of that side is gone, and there is a very free discharge of pus from it. The whole surface of the mastoid is swelled and excessively tender. A free incision was made down to the bone and a fistula was found leading into the tympanum. This was enlarged and a tent introduced and poultices applied. The patient remained under daily observation in New York for eight days, when he returned to his home to be under the care of his family physician. I saw him once or twice afterwards. He did well until July or August, when he died suddenly at a watering place, as I was informed, from meningitis.

CASE 5.—*Bronchitis ; acute suppuration of the right middle ear ; chills simulating ague and fever ; mastoid abscess opened with a drill ; death four days after.*

D. I., æt. sixty-nine, on April 6, 1886, was sent to my office by Dr. M. H. Williams with the following history : He had acute bronchitis three and a half months before, which in about two weeks was followed by earache. This ceased when the ear began to discharge, but the suppuration has continued ever since. The ear was carefully cleansed with warm water and an astringent instilled, and the ear was inflated by Politzer's method. There was occasionally some bleeding from the tympanum on cleansing.

The patient has excellent care under good hygienic conditions. To-day the patient has no pain, slight tinnitus occurred, but no other aural symptom.

H. D.  $\frac{F}{40}$  L.  $\frac{14}{40}$ . Bone-conduction better than ærial on that side. When the tuning-fork is placed on the sound mastoid it appears to be heard on the diseased side. This is a symptom which, as is well known, is quite often seen, and when it is, always in my opinion indicates advanced disease of the tympanum and cells, not necessarily suppuration however, with greatly increased resonance of these parts. The nares are in a catarrhal condition. The posterior half of the drum-head is swept away, the remainder is red ; a rather thick discharge from the tympanum. No tenderness, pain, swelling, or redness of the mastoid. Simple cleansing was advised. Nearly a month after, on May 4, 1886, I again saw the patient at his house and got the following history from Dr. Williams. The patient was doing fairly well until April 31st, when he had a chill followed by fever. He has had a chill nearly every day since. The mastoid is slightly tender at the apex, there is no œdema and no pain, but that side of his head feels uncomfortable. The next day the uncomfortable sensation had increased, and the usual incision was made through the integument and the bone opened with a drill. The depth reached was about one half an inch, when pus flowed out in considerable quantity. A tent was inserted and a poultice applied. In the evening the patient was very comfortable. Temp.  $98\frac{1}{2}^{\circ}$ . Pulse 78.

May 6th.—The patient had a chill lasting half an hour, and his temperature went up to  $104\frac{1}{8}^{\circ}$ . Two days after he died, hemiplegia having occurred.



CASE 6.—*Chronic suppuration of long standing; great pain in the head; delirium; opening of the mastoid; death.*

Male, æt. twenty-five. This patient was seen twice in consultation. The history was that he had had a suppurating ear on the right side for many years, and occasionally he has been laid up with earache. He has been sick now for two weeks. Pulse 90. Temperature 104°. The tympanum is suppurating moderately. The apex of the mastoid process is tender upon firm pressure, but there is no pain except in the head and that is not severe. The previous treatment has been the use of quinine and the application of leeches.

The diagnosis was meningeal hyperæmia from acute suppuration supervening upon chronic suppuration. Four leeches were advised, and poultices around the ear. I heard nothing more of the patient until fifteen days later. I was again sent for. The physician in attendance concluded that the high temperature was due to malarial poisoning, and has given large doses of quinine. He also made an incision through the periosteum of the mastoid process which has nearly healed. The patient is now delirious, flinches when pressure is made upon the mastoid. The mastoid was opened with a small drill into the cells. No pus was found. The blood was exceedingly dark, but there was no serious hemorrhage. The patient died three hours later. At my first visit to this patient I thought and expressed my opinion that the pus that formed on this case was probably inaccessible, for I supposed that the apex of the petrous bone or the roof of the tympanum rather than the mastoid was the principal seat of the disease. I did not concur in the use of the quinine, and never supposed that there was any determining malarial element in the case. When I got consent to opening the mastoid I did not hesitate, however, for I think many lives have been lost because concealed pus has not been evacuated in such cases. With my present convictions, in dangerous suppuration of the tympanum, I shall always lean towards opening the mastoid, believing as I do that such an opening secures the best drainage possible for the tympanum. Much as I deplore unsuccessful cases, I shall never hesitate to perform what I believe to be an operation almost without danger—in a doubtful and dangerous case. In a case to be described hereafter, occurring in the Manhattan Eye and Ear Hospital in my service and operated upon by Dr. Emerson with my assistance, a case almost desperate, life was, I think, saved by a timely trephining, although no pus was found.

CASE 7.—*Chronic suppuration of the middle ear since infancy; acute otitis; spontaneous opening of the mastoid process; enlargement of the opening; phthisis pulmonalis; death.*

C. P., æt. twenty-one. It is doubtful if death in the following case was due to the aural disease. Certainly it was not a result of any operative interference or other treatment. About three months after he was seen by Dr. Ely and myself in consultation with Dr. F. A. Utter, he died of phthisis pulmonalis. The history stated that the patient had had a discharge from the left ear for a long time from early youth. Four weeks ago he had violent pain in the ear extending to the side of the head and neck, a swelling in the mastoid opened spontaneously a few days since. The patient is very pale and weak. Temp.  $98\frac{2}{3}^{\circ}$ . Pulse 120. The entrance to the auditory canal is obstructed by granulations from the posterior wall. There is a small sinus below the tip of the mastoid. Rough bone is felt at the bottom. He has no pain now. The opening was enlarged and a tent inserted. The tissues are very boggy.

The patient got better so as to be up and about, a free opening into the mastoid cells was maintained, but the patient died in three months after.

CASE 8.—*Chronic suppuration of the middle ear; extensive necrosis of the mastoid process; epithelial tumor extending into the cranial cavity; no external swelling; death.*

In consultation with Dr. Mathewson. This case has been fully reported elsewhere (Transactions of the American Otological Society, 1878). This patient was a young married woman in good general health, who had had a purulent discharge from the left ear for ten years. When first seen by Dr. Mathewson and subsequently by myself, she was suffering pain from the ear. There were fungous granulations springing out of the tympanum. There was no swelling, tenderness, or pain in the mastoid.

Four months after first coming to Dr. Mathewson he opened the mastoid, which was still not swollen or tender, and very extensive necrosis was found. Two months after I again saw the patient. There was considerable pain in the head and ear. The mastoid opening was nearly closed. The canal was obstructed by granulations. The next day Dr. Mathewson removed many pieces of dead bone; a wide opening remained down to the dura mater. The patient died two months later, eight months after she came under Dr. Mathewson's care. A full account of the post-

mortem examination of this interesting case appears in the report. From this it appears that the growth had its origin in the tympanum, and that the mastoid was affected only at a late stage.

CASE 9.—*Acute suppuration of the middle ear ; redness and swelling of the mastoid ; bronchitis ; fistula of mastoid enlarged ; death.*

Male, æt. three. Seen in consultation with Dr. Emerson. The patient has had a discharge from his left ear for the past six weeks. For two weeks there has been redness of the mastoid process of that side, and slight swelling. There is no fluctuation nor tenderness on pressure. The auditory canal is much swollen. Dr. Emerson advised the hot douche and poultices, and nine days after he was called by Dr. Harrison to see the patient again. He learned that the little patient had had pain for two days. The swelling of the mastoid had nearly disappeared. There was no redness, but there was pain on pressure. The next day I saw the patient with Dr. Emerson. He made a Wilde's incision, found a fistula in the bone, which he enlarged. The patient slept well the night after this, but he died three days after in a convulsion.

#### DEATHS FROM CASES OCCURRING IN HOSPITAL PRACTICE.

The only death I have seen from aural disease in my service at the Manhattan Eye and Ear Hospital for eighteen years occurred last summer, and was that of a patient under the care of Dr. Emerson and myself.

CASE 10.—*Sub-acute suppuration of the middle ear ; mastoid tenderness ; opening of bone ; no fistula or pus found ; death in forty-two days.*

Male, laborer, thirty-seven, was treated as an out patient for two weeks before he entered the hospital. He said he had a painful ear for three weeks before this. The warm douche and leeches have been used. On admission to the hospital, on June 9, 1877, he complains of dizziness and pain. He was found to have a sub-acute suppurative process in the middle ear. He apparently improved under local treatment for three days, when he had a chill and his temperature went up to 103°.

The mastoid was opened by Dr. Emerson, assisted by myself, on that day. The bone was drilled to the depth of one inch. No pus and no fistula were found, and there was no softening of

the external plate. The temperature fell to  $100^{\circ}$  that evening, but it rose the next day to  $103^{\circ}$ . The patient was chilly, nauseated. He continued to suffer from nausea for several days; his temperature ranged from  $101^{\circ}$  to  $103^{\circ}$ , and on June 21st it arose to  $105^{\circ}$ . On this day his pulse was increased to 80 for the first time. It had before ranged from 72 to 76. He now has delirium at times. He is given quinine and bromide of potassium. On the 22d he had a chill lasting an hour. The discharge of pus from the ear is scanty. He continued in about this way for three days, when his temperature fell to  $98\frac{1}{2}^{\circ}$ , and the next day to  $97^{\circ}$ . He continued to have chills, and on June 28th his pulse was 120. An examination of the optic nerve and retina showed nothing abnormal. From July 5th the following notes were made by the house surgeon, Dr. Rogers:

*July 5th.*—More discharge from fistula. Mental condition unchanged. No sleep last night; greatly emaciated. Slept three hours P.M. Chill at 10.30 P.M.

*July 6th.*—Slept some; cough at times. Condition like yesterday. Sleeps with eyelids half shut. Profuse perspiration. Chill at 6 P.M.

*July 7th.*—Did not sleep well. Violent; wanted to go home. Sleeping, 8:30 A.M. Complains he can't see as well as two days ago. Does n't take as much nourishment. Iod. potass.

*July 8th.*—Deviation of both eyes was noticed this P.M.

*July 9th.*—Slept well. Anodyne continued. Iodide discontinued. Perspiration not so profuse. Seems stronger; pulse and temp. normal—P.M., 72,  $98\frac{2}{3}^{\circ}$ .

*July 10th.*—Same as yesterday; appetite good. P.M., chilly sensations.

*July 11th.*—Slept well. More discharges from fistula. Mind wanders.

*July 12th.*—Did not sleep. Violent delirium. Appetite not so good. One P.M., severe chill and temp.  $102\frac{4}{5}^{\circ}$ . Drs. Webster and Emerson at 4 P.M. diagnosticated marked change in optic nerve, left eye, less marked in right; both pupils sluggish and dilated. Mydriasis most marked in left eye.

*July 13th.*—Slept badly; expectoration of considerable mucus, stringy and about half-brownish color. Evidences of consolidation on right side.

*July 14th.*—Slept well. Appetite good; increased stimulant to 4 oz. per day. Free perspiration.

*July 15th.*—Slept considerably through the day. More pus in mastoid opening than usual. Temp. at 7 P.M.  $104^{\circ}$ . Cough and expectoration continues.

*July 16th.*—Appetite poor. Pus corpuscles abundant in sputa (?); delirium marked; tendency to cry. More pus this P.M.

*July 17th.*—More quiet; clot of blood in sputa, dark-colored, probably from post-nasal region. Appetite good. Rests well.

*July 18th.*—Expectorates freely. Temp. rises to  $104^{\circ}$  at 7 P.M.

*July 19th.*—Morning temp.  $100^{\circ}$ . No general change from yesterday.

*July 20th.*—Very restless last night. Out of bed continually unless closely watched. Appetite good. Morphine, chloral, and bromide of sodium given every six hours.

*July 21st.*—Tendency to cry. Less violent and expectorates less; bowels more constipated; takes nourishment well.

*July 22d.*—Slept well; more rational.

*July 23d.*—Pleuritic pains, right side.

*July 27th.*—Picks bedclothes more than for past few days. Seems weaker; pulse and temp. higher.

*July 28th.*—Only slight expectoration. Takes only liquid foods.

*July 29th.*—Urines unconsciously. Cough easier; much mucus in throat.

*July 30th.*—Temp., respiration, and pulse quickening.

*July 31st.*—Sinking slowly. Died at 12:10 P.M.

This case was, I think, one of septicæmia, and the purulent infection was in the roof of the tympanum or at the apex of the petrous bone. We were not hopeful of the results of opening the bone, but we desired to obtain an outlet for pus, but in this we were not successful.

I will next discuss the **cases in which a cure resulted after operation**, and will select a few cases from the table for this purpose.

*CASE II.—Caries of the mastoid from chronic suppuration of the middle ear; mastoid opened three times; recovery.*

Miss X., æt. twenty-six. As this case is reported in my book on the ear, p. 529, I will simply say that the patient was under observation and treatment for some eight months. Although the bone had been opened twice before I saw the case, once with a

chisel, the patient, who is a teacher, was unable to do any mental work on account of pain and dizziness. After a thorough opening up of the old fistula with a drill, and subsequent persistent curetting of granulations, the patient entirely recovered; the drum-head did not heal however; she resumed her duties, which, ten years later, she still continues to perform without trouble from her ear.

To my mind, a case of mastoid disease arising in the course of a chronic suppuration always, or nearly always, involves a tedious course varying from two to six months if cure results. It is otherwise with the same form of disease arising in the course of acute catarrh and acute suppuration. In such cases the recovery may be rapid and death also may speedily result. He who succeeds in curing cases where he has opened the mastoid *de novo*, or enlarged a fistula, must expect weeks of rather dreary work of keeping the opening free, by frequently curetting the granulations, picking away the minute fragments of dead bone, pushing in a tent, a drainage-tube, or the like. With such patience, success will generally crown the effort.

I am very unwilling to operate upon a case unless either one of my staff or myself or a competent surgeon, alive to the importance of the prevention of retention of pus, have the subsequent charge of the case. The after-treatment, I think, invokes much more skill than the operation.

CASE 12.—*Caries of mastoid of nasal bone and of jaw; removal of pieces of dead bone from various parts; recovery.*

Female, æt. five. This case also illustrates what has just been said on the subject of keeping up the openings in the bone until the last of the unhealthy tissue is removed.

The child was apparently a healthy one of healthy parents. She was sent to me by the late Dr. Lewis Fisher, and she was under the care of Dr. Ely and myself for more than four years. A mastoid fistula existed when I first saw her, when she was three years of age. Dr. Abbot, dentist, of this city, had the care of the caries of the jaw; she was etherized several times, to keep open the original enlargement of the bone fistula and to remove granulations from the tympanum. Finally she recovered with a neoplastic non-suppurating tympanum, and the mastoid fistula healed.

Several cases have recovered without perforation of the mastoid by, getting the patient in bed under the charge of a trained nurse, and the free use of the warm douche, leeches and poultices. Most of the patients who have been thus relieved have been of decided neurotic tendencies, and although they have had great tenderness and pain in the mastoid, have probably never had more than periostitis. No caries occurred, except in some instances caries of the wall of the auditory canal, when it opens into the mastoid.

I have written upon this subject at some length in the ARCHIVES OF OTOTOLOGY, vol. viii., p. 255, and I will not repeat what I then said.

A case which I have lately seen in consultation with Dr. F. W. Ring, and which we treated together in the Manhattan Eye and Ear Hospital, re-illustrates the points I then endeavored to make.

*CASE 13.—Acute suppuration both middle ears; red, sensitive, and tender mastoid; increase of temperature; no operation; recovery.*

Mrs. G., æt. twenty-five. Nov. 30, 1886.—Five months previously the patient suffered from acute suppuration of both middle ears, while in the West Indies. The suppuration and pain have continued at intervals ever since.

Occasionally she is quite well. She has been under Dr. Ring's care for more than two months. Under his treatment the right drum is now healed; R *h d*  $\frac{4}{8}$ . Bone-conduction better; L *h d*  $\frac{1}{4}$ ; B C better. There is pus in the left tympanum. The mastoid of that side is reddish, painful, and tender. The temperature at about 11 A.M. was  $102^{\circ}$ , and had been for a few days. She was anæmic and neurotic. She lived in a boarding-house and had insufficient care. On the advice of Dr. Ring and myself she was admitted to the hospital. She was kept in a quiet room, was fed with milk, chiefly stimulants, latterly champagne was given pro-re-nata, massage. Her temperature sank to normal in a few hours after getting under hospital care. The right drum-head again broke down, but finally healed. Locally the hot douche and poultices were used. She was discharged cured. She went to Chicago, had a mild attack of acute suppuration without mastoid trouble, from which she completely recovered in twenty days.

One of my cases at the Manhattan Eye and Ear Hospital, one in which I found a fistula in the bone and enlarged it, developed acute facial erysipelas. The temperature, without the administration of medicine, fell in one day from  $104^{\circ}$  to  $97^{\circ}$ . The shock was great, but the patient rallied and made a good recovery. The drum-head healed. Facial erysipelas also occurred in another case where the operation of drilling the bone was performed by Dr. F. Tilden Brown, then one of my assistants. This case may be found in my book, page 522, and in these ARCHIVES, vol. xii.

The following case, which occurred in private practice in consultation with Dr. E. M. Pulling, and has a peculiar interest from the fact that *descending optic neuritis resulting in atrophy occurred*.

CASE 14.—Willie X., æt. six. *April 10, 1885*, has had pain and discharge from his right ear for some days. He is in bed. Temperature  $100\frac{1}{2}^{\circ}$ . The right membrana tympani is perforate. There is inspissated pus in the tympanum. The mastoid process is red and swelled. An incision was made down to the bone, about one ounce of thick pus was evacuated. The periosteum was found to be extensively diseased, but no fistula in the bone was found. The patient slept well that night and recovered. Case went on well as to the ear. Dr. Pulling afterwards made counter-openings to prevent burrowing, but no opening in the mastoid bone was ever made, and on March 2d of this year I again examined him. I found two linear scars on the mastoid, the membrana tympani is sound and has good light spot, and is of good color. H D  $\frac{20}{48}$ ; A C better than B C.

The peculiar interest in the case is found in Dr. Pulling's account of the subsequent progress of the case and in the results of the ophthalmoscopic examinations which I made. Dr. Pulling writes: "After you last saw Willie he had meningitis, lasting four to five weeks. He took bromides in full doses with aconite and so forth, when the temperature rose. His condition gradually improved, and at the end of two months or more from the date of your last examination his health seemed quite well established. About this time, however, it was observed that his vision was becoming defective. The impairment of sight I assumed to



be due to constriction of the optic nerve from contraction of the tissues about it."

The patient now, March 2, 1877, has only perception of light in the right eye and  $\frac{6}{200}$  on the left. Both optic papillæ are in a state of white atrophy. The lateral vessels have all disappeared from the right papilla.

It is no new observation to find basilar meningitis in the course of acute inflammation of the tissues of and adjacent to the temporal bone. Our attention has been called by Kipp, Andrews, and others to the usefulness of ophthalmic examinations in the course of diseases of the mastoid, but I think it very unusual for a patient to recover from a suppurative inflammation of the tympanum, with mastoid periostitis, to become blind from optic neuritis and subsequent atrophy.

I have now under observation in private practice three cases of mastoid disease, of which I will give an account.

*CASE 15.—Scarlet-fever; acute suppuration of the right middle ear; pain in the head; swelling and redness of the mastoid; incision through the periosteum; fistula found and enlarged; still under treatment.*

Miss W., æt. fifteen. The patient was attacked by scarlet-fever on Nov. 3, 1886. On the 13th she was seized with a severe pain in the head and with pain in the ear. These pains continued for several days until the membrana tympani broke, when the pain was materially relieved.

The pain in the head continued, however, accompanied by a free purulent discharge from the auditory canal, until February 5th—about three months. I then saw her for the first time, and found the patient anæmic and evidently suffering. The right membrana tympani was nearly gone, and the tympanum velvety. The left drum-head was intact. No tenderness or redness of the mastoid. The hot douche was prescribed, and the ear kept clean. Four days after the patient had severe pains through the temples at the apex of the mastoid. Leeches were applied, and relief given for two or three days, but on Feb. 14th the pain reappeared. There was found to be considerable swelling and redness of the mastoid. At 5 P.M. the temperature was  $101\frac{3}{4}^{\circ}$ .

An incision was made, the periosteum removed, and a fistula

found leading from above the middle of the process into the tympanum. Some pus came from this. This was enlarged with a drill. A tent and poultice applied. She began to improve the next day, and her condition at this writing, a little more than four weeks from the operation, is as follows: No headache, anæmia disappearing, scarcely any discharge from the tympanum, and a moderate suppuration passes through a drainage-tube inserted into the mouth of the fistula in the bone. Temperature normal. Patient goes out.

March 31st.—Fistula in bone has healed. Membrana tympani restored. H D,  $\frac{5}{18}$ .

CASE 16.—*Chronic suppuration of the middle ear; mastoid periostitis; openings down to the bone; enlargement of the fistula; patient still under treatment.*

H. B., æt. sixteen, was brought to me March 4, 1887, by Dr. W. H. Cummings, of Honesdale, Pa., on account of pain in the head, dizziness, and occasional swellings of the mastoid process.

The hearing distance on the right side is normal. The drum-head is cicatricial and intact. The left mastoid process is depressed, and has a minute opening, about which the tissues are boggy. A fine probe passed into it can with difficulty be made to enter the bone. The auditory canal was half filled with sanious pus. It was believed that the tympanum and mastoid were the seat of purulent inflammation, and that they were not well drained.

That day the patient was etherized at the Post-Graduate Hospital, a free incision was made down to the bone, the minute fistula enlarged with a drill and the gouge. The tissue of the mastoid was found to be very soft, and an opening into the tympanum about one fourth of an inch in diameter was easily made. A large quantity of cheesy, inspissated pus, as well as that of a fluid quality, was evacuated. The patient is steadily improving, has no headache or dizziness. Whether or not he will have a permanent fistula remains to be seen. The mastoid tissues have been previously opened several times down to the bone, but not into it, but for the first time thorough drainage has been secured.

CASE 17.—*Acute suppuration of the right tympanum; mastoid red, tender, and swelled; fistula found; enlarged; relief; still under observation.*

On March 1, 1887, I was asked by Dr. W. A. Dayton to see a

female child of six years with the following aural history : During the holidays she had the earache several times, generally in the night, with some regularity at about 1 A.M. These attacks continued at intervals until Feb. 22d, when they became more constant. Her pulse was then 115. Her tongue was coated, the skin dry. The tympanum discharged very moderately ; the mastoid process became red, tender, and swelled. Leeches and poultices were applied with only partial relief.

On March 1st I examined the ear. I found the drum-head perforate, caseous pus lying upon its remains, the mastoid as above described. I advised an incision down to the bone, in the usual way. This was made by Dr. Dayton ; no pus was found, but a small fistula was discovered about one fourth of an inch above the apex of the mastoid, with softening of the bone about. This was enlarged and a tent introduced.

*March 2d.*—The relief has been very great.

*March 19th.*—There has been no pain since the operation. The wound, previously syringed with weak carbolized water, has been tightly packed every day with a twelve-inch tent.

Granulations have sprung up in the wound rapidly ; these have been trimmed away daily with curette and scissors. The use of a four-per-cent. solution of cocaine has rendered the treatment almost painless.

There has been no pus (from the beginning) save that which comes away on the tent. The child has been kept in bed, in a bright, sunshiny room, and allowed a generous diet, meats only prohibited.

In this case the inflammation has been rather plastic than suppurative, or predominantly of the former character.

*CASE 18.*—*Acute suppuration of the tympanum ; severe pain ; diplopia ; mastoid opened ; no pus ; no fistula ; recovery in four months ; fistula closed in about a year.*

A. M., æt. forty-six, colored, June 25, 1885.

For five weeks this patient states that he has suffered from a purulent discharge from the left auditory canal. For much of this time he has suffered much pain. He now has a suppuration of the tympanum, and complains of severe pain.

Two leeches were applied to the tragus, and morphia was administered hypodermically at bedtime. Warm douche to the canal.

*July 5th.*—The patient has been very comfortable for a portion of the time, but he has had considerable pain ; referred to the left side of the head. Besides the hot douche, poultices have been applied about the ear at times. It has been necessary to give morphia every night. The discharge has been profuse. This evening his temperature is  $101^{\circ}$ .

*July 6th.*—The patient has homonymous diplopia, the left external rectus being paralyzed.

*July 7th.*—Diplopia and pain continued. At about 4 P.M. the mastoid was opened with a drill. Dr. Emerson operated, assisted by Dr. Roosa. No pus, no fistula were found. A tent was placed in the opening and a poultice applied.

*July 9th.*—The patient has had no pain since the operation. Paralysis of the external rectus continues. The examination with the ophthalmoscope detects no lesion of the fundus oculi.

*July 11th.*—Yesterday a free discharge of pus occurred from the mastoid cells. He also had pain in the head and back of the neck, lasting three or four hours. This is the first since the operation, and at 5 P.M. his temperature was much higher and his pulse more frequent than at any time since the operation. This morning he is sweating profusely. The discharge from the ear is abundant.

The patient was taken from the hospital for a time, but reappeared in a few days.

*August 6th.*—He is now up and about his room. His temperature from August 5th to the 12th ranged from normal in the morning to  $104^{\circ}$  in the afternoon.

The fistula in the bone is free, and the patient has no pain.

On August 20th the patient again left the hospital. He reported daily, and was readmitted in about a month. The granulations were removed from the sinus by a curette, and the opening kept free. On October 14th he was discharged, without pain ; the diplopia disappeared. Some thirty days since, the fistula still existed. The patient made a perfect recovery, and is still living. The fistula closed ; abscesses occurred in the neck.

In another case, alluded to in this paper and fully reported in these ARCHIVES, vol. xii., 1883, diplopia also occurred during the course of erysipelas, which supervened upon the operation of opening the mastoid. It is remarkable that no pus was found on opening the mastoid. It soon, how-

ever, made its way through, and the fistula thoroughly drained the tympanum, and thus gave relief, and recovery ensued. I can but think that a fatal result might have ensued had not the mastoid been opened.

CASE 19.—*Acute suppurative inflammation of the tympanum; healing of the drum-head in two weeks; mastoid abscess; removing of pus; opening of mastoid; subsequently, deep abscesses of the neck; recovery.*

C. P., æt. twenty-three. Patient was admitted to the hospital on Sept. 3, 1886, and gave the following history :

Three months previously he had an acute suppuration of the left tympanum. The drum-head is said to have healed in two weeks. After this he suffered from severe headaches from the occiput around to the frontal region. A swelling behind the ear occurred a month ago, and since that time he has not suffered much from pain. The mastoid region is found to be swollen, but not red or tender. His hearing distance is  $\frac{3}{4}$  ft., and the membrana tympani is intact. The neck is also swollen down to the clavicle. On Sept. 26th Dr. Emerson opened the mastoid cells with a drill. Pus was found in the cells. A tent and poultice were applied. In four days the great swelling of the neck had subsided, and pus was freely discharging from the opening in the bone. The patient is anæmic and feeble. Whiskey and iron and milk are given. The swelling of the neck reappeared and became greater than before the operation. An incision along the sterno-cleido-mastoid was made by Dr. Roosa on October 17th, and a careful dissection made under the muscle, and a large quantity of pus evacuated. Iodoform dressing was applied and a rubber drainage-tube introduced. An exploratory incision made some days before failed to find pus, but the operation of to-day showed that it has been burrowing for a long time. From this time the patient began to recover, and was discharged from the hospital on Dec. 10th with one drainage-tube leading down to the bone but not in it. For a long time previously the patient had three drainage-tubes—one into the fistula of the mastoid, one along the side of the sterno-cleido-mastoid, and one over the border of the occipital bone. For some time they communicated with each other.

The marked feature in this case was the complete healing of the membrana tympani with almost complete restoration

of the hearing, while the disease went on in the mastoid bone and extended from there deep into the cervical tissue.

CASE 20.—*Acute suppuration of the middle ear ; mastoid ; abscess ; fistula ; operation ; relief.*

Bertha X., æt. thirteen, was brought to me by her father, a physician, Feb. 28, 1885, suffering intensely at times from pain referred to the left ear. The history states that she had severe pain in the ear on the Christmas day preceding, and that the ear had soon begun to discharge pus, and that it has continued to do so. The hearing distance is  $\frac{c}{40}$ . The bone-conduction is better than the ærial on that side. The drum-head is gone posteriorly, and there is a free discharge of pus from the tympanum. The mastoid region is red, swollen, and tender. The patient is of a delicate anæmic type.

On the same day the mastoid was incised, pus evacuated, a fistula leading into the tympanum was found and enlarged. A tent was applied. Relief to the pain soon followed. The patient was treated in the Manhattan Eye and Ear Hospital for some three months. The bone about the fistula was found exposed. The fistula was enlarged with a drill at the time of the operation, and kept open by the use of the curette ; granulations sprang up very readily.

Feb. 23, 1887.—The patient is still under observation. The fistula has not yet healed, and pus discharges from both the auditory canal and the mastoid, but granulations do not form. The patient's general condition is decidedly better.

The prominent feature in this case is the fact that the fistula had not healed in one year after the operation. This may be due to two causes: 1, the delicate health of the patient ; 2, the care of the patient at home—that is, in regard to keeping the fistula and tympanum clear—has not been quite as thorough as when the patient was under daily treatment at the hospital. To keep a fistula free from granulations often causes so much pain that a tender parent, even if a physician, will not always do it.

CASE 21.—*Acute suppuration of the middle ear ; thickening of the tissues over the mastoid ; no tenderness or pain ; recovery without operation.*

Mrs. H., æt. thirty-three, was brought to my office on June 11,

1886, by Dr. John C. Peters, who desired my opinion as to treatment of her ear. The patient stated that some twelve weeks before, she was seized with a pain in the right ear. After using the nasal douche there was soon a discharge of pus from the auditory canal, which has continued ever since. The hearing distance on the right side is  $\frac{P}{48}$ ; on the left,  $\frac{48}{8}$ . At times she has considerable pain in the ear and the right side of the head. The tissues over the mastoid process were considerably thickened, but there was no redness, swelling, or tenderness. The drum-head was perforate, about half of the membrane being gone, and there was a free but not excessive discharge of muco-pus. The patient, who was a well-developed woman, appeared to be in a high state of nervous excitement. She stated that she had been under the care of several physicians, and that this morning the last one whom she had consulted advised that the mastoid be opened to-day; another had said she had syphilis, and so forth. Before she had made the statement in regard to an operation, I had advised Dr. Peters that his patient be kept in her room and that the ear be treated by the use of the warm douche and poultices, the latter in case of pain. After the statement as to the urgent need of an operation I again went over the case, but in view of all the symptoms I concluded that the drainage of the tympanum was sufficient, and that what was now needed was absolute mental and bodily quiet. The patient was treated in the manner indicated, leeches were applied to the tragus the next day, and poultices were used in front and behind the ear. The temperature remained normal, and while she was under my observation, some ten days, she steadily improved, and finally became well as to her general health and had no pain referred to her ear. There remained an opening of the membrana tympani when she was last seen by me and a slight muco-purulent discharge, but I have been informed by her mother, within a few days of writing this, that the patient, now nine months since, is perfectly well.

In this case, the patient's natural disposition and undisciplined mind led her to exaggerate her symptoms, especially as regards pain. Then again she has kept herself in a state of excitement by running about to various physicians, when the actual objective conditions were really not at all grave. At any rate, I felt that with a tympanum well open, a mastoid scarcely tender on the very firmest pressure upon

the apex, with no fever, and a brief history of aural disease, in a person excited by her frequent change in advisers, that delay was certainly proper. Much as I advise opening the mastoid when the indications are even moderately plain, and the conditions are urgent, I am always very anxious not to perform an unnecessary operation. The case belongs to the same class as that reported in full in this paper, Case 13, and the one reported in the ARCHIVES, and before alluded to in this article, where neurotic symptoms predominated over the inflammatory. I ought to add that after a thorough examination, neither Dr. Peters nor myself thought the patient had syphilis.

I have not been able, without unduly lengthening this paper, to give the details of all the interesting cases which I have not before published, but enough certainly are furnished, with the contributions of other writers, to vindicate, if vindication be necessary, the performance of Wilde's incision and, in case of need, of making opening into the mastoid cells.

If operative procedures are necessary for the drainage of the tympanum, certainly as a rule, they are best and most safely performed through the mastoid cells. In some instances these may be best reached, however, by an opening in the auditory canal. Such an operation as this, however, is not to be confounded with operations which aim to remove the remains of the drum-head and the contents of the tympanum. The latter, in my opinion, are dangerous and insufficient procedures, that have no advantages in the treatment of intractable chronic suppuration of the middle ear over perforation of the mastoid. Besides, the removal of the ossicles, and so forth, must be exceedingly difficult on account of the narrowness of the field of operation and the difficulty of knowing just what one is doing.

All of us know that even the operations for the removal of granulations deeply seated in the tympanum, become very difficult on account of the free bleeding, which soon renders all exact and delicate manipulation almost impossible.



*Table Showing the Relative Frequency of Affections of the Mastoid in certain Eye and Ear Hospitals, and in the writer's private practice.*

Name of institution.	Total No. of aural cases.	No. of years.	Affections of the mastoid.	Operations.
Manhattan Eye and Ear Hospital.	14,720	17	110	Wilde's incisions and opening of mastoid, 105. (Wilde's incision, 94. Enlargement of a fistula, 5. Perforation, 6.) One opening through auditory canal.
Brooklyn Eye and Ear Hospital.	18,366	18	91	126 Wilde's incisions and perforations of the mastoid.
New York Ophthalmic and Aural Institute.	14,634	17	112	Wilde's incisions, 108. Perforations of the mastoid, 22. Opening through auditory canal, 1. Total, 131.
Massachusetts Charitable Eye and Ear Infirmary.	9,533	3	62	Operations not fully recorded.
Newark Charitable Eye and Ear Infirmary.	3,021	3	22	15
Illinois Eye and Ear Infirmary.	2,464	4	8	16
New York Charity Hospital.	20	1	1	1
Author's Private Practice.	5,797	22	59	42

*Percentage of Affections of the Mastoid.*

Aural cases.	Mastoid cases.	Per cent.
14,720	109	.74
18,366	91	.49
14,634	112	.76
9,533	62	.65
3,021	22	.72
2,464	8	.32
20	1	.05
5,797	59	1.01
68,555	464	.67

*Aural Cases Observed in Private Practice in*

No.	Age.	Sex.	Form of original disease.	Treatment.
1	56	Male.	Acute suppuration of the middle ear.	Wilde's incision. Poultices.
2	55 about	Male.	Nasal polypus; removal; use of nasal douche; acute catarrh of the middle ear.	Leeches. Poultices.
3	50	Male.	Chronic suppuration, middle ear, of four months' standing.	Wilde's incision. Pus evacuated.
4	30	Female.	Acute inflammation of the middle ear.	Warm douche. Poultices.
5	38	Female.	Acute inflammation of the middle ear.	Wilde's incision by Dr. Agnew. Pus evacuated.
6	30 about	Male.	Naso-pharyngeal catarrh; use of nasal douche; acute suppuration of middle ear.	Leeching. Poultices.
7	13	Female.	Chronic suppuration of middle ear.	Wilde's incision. Pus evacuated.
8	70	Male.	Chronic suppuration of middle ear.	Wilde's incision. Bone fistula found enlarged.

No.	Age.	Sex.	Disease exciting present attack.	Treatment.
9	30	Female.	Acute suppuration of middle ear.	Wilde's incision. No pus.
10	39	Male.	Primary mastoid periostitis.	Leeches.
11	3 mos.	Male.	Acute inflammation of middle ear.	Wilde's incision. No pus.
12	45 about	Male.	Sub-acute suppuration of middle ear.	Leeches.
13	26	Male.	Acute inflammation of middle ear.	Wilde's incision. No pus.
14	41	Male.	Acute suppuration of the middle ear.	Wilde's incision. Fistula found.
15	1 year	Female.	Chronic suppuration of middle ear.	Wilde's incision. Pus evacuated.
16	50	Female.	Chronic suppuration of middle ear. (Mastoid abscess, caries.)	Leeches. Hot douche.
17	27	Female.	Inflammation of external auditory canal.	Leeches. Wilde's incision.
18	60	Female.	Acute suppuration of the middle ear.	Wilde's incision. No pus.
19	21 mos.	Female.	Chronic suppuration of the middle ear from measles.	Wilde's incision. Pus evacuated.

<sup>1</sup> Cases in which the apex of the petrous bone was the chief seat of lesion, been excluded from this table.

which the Mastoid Process was Seriously Involved.<sup>1</sup>

Duration.	Result.	Remarks.
45 days.	Cure, membrana tympani headed.	Patient had an acute catarrh of the tympanum two weeks later, recovered under use of leeches in a few days.
60 days.	Cure.	Pyæmia occurred; case reported, <i>Archives of Ophthalmology and Otology</i> , vol. i., p. 359.
4 days.	Was relieved when last seen.	Polypus also removed from canal.
3 days.	Cure.	
Unknown.	Cure.	Seen in consultation.
Some months.	Died in a few months. Death said to have resulted from disease of the brain.	Seen in consultation with Dr. Loring. Account of final result given to writer by Dr. J. W. Warner.
4 weeks.	Cure.	Drum-head did not heal. See author's text-book, p. 499.
4 months.	Cure.	Seen with Dr. Loring. Reported in author's text-book, 6th edition, p. 496.

Time under observation.	Result.	Remarks.
16 days.	Relieved.	Final result unknown.
1 day.	Unknown.	
A few days.	Died.	In consultation with Dr. Williams; full account in body of the paper.
1 day.	Unknown.	
1 month.	Cure. Drum-head healed.	Mastoid periostitis occurred the sixteenth day after the ear was first affected.
Some months.	Cure. Bone fistula healed.	
1 day.	Unknown.	Seen with Dr. Jenkins, of Vonkers.
A few days.	Died.	Fully reported in body of article.
11 years.	Cure.	Still has eczema of the auditory canal.
A few weeks.	Cure. Drum-head healed.	In consultation with Dr. O. J. Ward.
Some days.	Relief of acute symptoms.	

and those of cerebral abscess without serous symptoms in the mastoid, have

No.	Age.	Sex.	Disease exciting present attack.	Treatment.
20	26	Female.	Chronic suppuration of middle ear.	Wilde's incision and enlargement of fistula with a drill.
21	28	Female.	Chronic suppuration of middle ear.	Mastoid trephined by Dr. Mathewson.
22	42	Male.	Acute suppuration of middle ear.	Leeches. Wilde's incision. No pus.
23	15	Male.	Chronic suppuration of middle ear.	Wilde's incision. No pus.
24	9	Male.	Chronic suppuration of middle ear from scarlet-fever.	Removal of polypus.
25	47	Male.	Acute suppuration of middle ear.	Opening of mastoid with drill.
26	42	Male.	Acute catarrh of middle ear.	Paracentesis of membrana tympani. Wilde's incision. No pus.
27	33	Male.	Naso-pharyngeal catarrh; used nasal douche; acute suppuration of middle ear.	Wilde's incision. Dr. Chas. Phelps. Fistula found.
28	5	Female.	Chronic suppuration of middle ear; spontaneous opening of mastoid.	Enlargement of mastoid fistula. Necrosed bone removed.
29	28	Female, colored.	Exostosis, mastoid process; no other disease of the ear.	
30	21	Male.	Chronic suppuration, middle ear; fistula, mastoid.	Fistula enlarged. Granulations removed.
31	20	Male.	Chronic suppuration of middle ear.	Wilde's incision, and enlargement of fistula with drill.
32	30	Female.	Acute suppuration of middle ear.	Hot douche and poultices.
33	26	Male.	Acute suppuration of middle ear.	Leeches. Poultices. Warm douche.
34	5	Male.	Acute suppuration of middle ear.	Wilde's incision. Fistula found.
35	7	Male.	Acute suppuration of middle ear.	Hot douche. Poultices.
36	19 mos.	Female.	Acute suppuration of middle ear, with facial paralysis.	Opening mastoid through external auditory canal.
37	38	Female.	Chronic non-suppurative inflammation of middle ear, with facial paralysis and periostitis of mastoid.	Mercury and iodide of potash.
38	19	Male.	Acute catarrhal inflammation of the middle ear.	Leeches. Poultices.
39	60	Female.	Chronic suppuration of middle ears since childhood.	Counter-irritation.
40	4	Female.	Acute suppuration of middle ears with mastoid; fistula and facial paralysis.	Enlargement of fistula. Removal of nearly the whole of the temporal bone.
41	35	Male.	Acute suppuration of middle ear.	Opening of mastoid cells with chisel.
42	36	Male.	Acute suppuration of middle ear.	Leeches. Poultices. Incisions in auditory canal.
43	7	Female.	Acute catarrh of middle ears; malarial poisoning.	Quinine internally. Poultices. Hot douche.

Time under observation.	Result.	Remarks.
2 years.	Cure. Drum-head did not heal.	Reported in author's text-book, page 321.
3 months.	Relief to pain for some time. Disease recurred.	Full account in body of article.
28 days.	Death from meningitis.	Reported in author's text-book, p. 310.
Several months.	Cure.	Patient now said to be dying of phthisis, some ten years later.
30 days.	Relief.	Mastoid had been previously perforated and healed.
1 year.	Cure.	Reported in author's text-book, p. 320.
Some months.	Cure.	Facial paralysis occurred. Reported in ARCHIVES OF OTOTOLOGY, vol. viii., page 355, and in author's treatise, page 321.
18 months.	Cure. Fistula remained open 18 months.	
3 years.	Cure.	
3 months.	Died of phthisis pulmonalis 3 months after.	Details in body of article.
8 days.	Died some months after of meningitis.	History given in full in body of this article.
3 days.	Relieved.	
1 month.	Cured.	
1 month.	Cured.	Dr. Dew performed the operation.
23 days.	Cured.	
8 weeks.	Cured.	Operation performed by Dr. Blake White.
33	Cured. (Facial paralysis remained when last seen.)	
20 days.	Cured. Drum-head healed.	Treated by Dr. J. B. Emerson.
4 months.	Cured. Drum-head healed.	
1 year.	Cured. Permanent fistula in bone.	Reported in full in ARCHIVES OF OTOTOLOGY, vol. xv.
2 weeks.	Cured.	In consultation with Dr. Gruening. Operation by Dr. Gruening.
6 months.	Relieved.	
3 months.	Cured. Drum-head healed.	

No.	Age.	Sex.	Disease exciting present attack.	Treatment.
44	13	Female.	Acute suppuration of middle ear.	Wilde's incision, with enlargement of fistula by drill.
45	6	Male.	Acute suppuration of middle ear.	Wilde's incision. Pus evacuated.
46	69	Male.	Bronchitis; acute catarrh; acute suppuration of middle ear.	Mastoid opened with drill.
47	25	Male.	Chronic suppuration of middle ear.	Opening of mastoid with drill.
48	21 mos.	Female.	Acute suppuration of middle ears.	Wilde's incision. Enlargement of fistula.
49	30	Female.	Acute suppuration of middle ear from use of nasal douche.	Warm douche. Poultices.
50	52	Male.	Inflammation of external auditory canal.	Warm douche.
51	25	Female.	Acute suppuration of middle ears.	Warm douche. Poultices.
52	43	Male.	Acute suppuration, right middle ear.	Warm douche. Poultices.
53	16	Female.	Neuralgia, middle ear.	Tonics. Change of air.
54	15	Female.	Acute suppuration of middle ear from scarlet-fever.	Wilde's incision. Fistula found and enlarged with drill.
55	16	Male.	Chronic suppuration of middle ear from scarlet-fever, with mastoid fistula.	Wilde's incision. Pus evacuated.
56	38	Male.	Sub-acute catarrh of middle ear.	Wilde's incision.
57	6	Female.	Acute catarrh of the middle ear.	Wilde's incision. Soft bone broken down with a probe.
58	3	Male.	Chronic suppuration of middle ear.	Wilde's incision. Fistula found and enlarged with drill.
59	4	Male.	Chronic suppuration, middle ears, from scarlet-fever; fistula in both mastoids.	Enlargement of fistula with drill.

<sup>1</sup> Since writing this paper I have received a note from this patient stating that

Time under observation.	Result.	Remarks.
2 years.	Relieved. Fistula still open.	Fuller report in body of article.
2 years.	Cured. Drum-head healed.	Meningitis. Atrophy of optic nerves. Fuller report in body of article.
1 month.	Died.	Full report in body of article.
15 days.	Died.	Fully reported in body of article.
1 year.	Cured.	
6 months.	Cured.	Fully reported in body of article.
1 month.	Cured.	
2 months.	Cured.	
1	Unknown.	Started for San Francisco next day. <sup>1</sup>
1 month.	Cured.	
50 days.	Relieved.	Under treatment. Membrana tympana healed.
17 days.	Relieved.	Still under treatment.
1 month.	Died.	Reported fully in author's treatise, page 512.
20 days.	Relieved.	Operation by Dr. Dayton. Report in body of article.
13 days.	Died.	Full report in body of article.
1 month.	Relieved.	

he is well. This reduces the number of results unknown to three.

*Statistics of Cases of Disease of the Mastoid in the*

No.	Age.	Sex.	Disease exciting present attack.	Treatment.
1	12	Female.	Subacute catarrh of middle ear.	Wilde's incision. Pus evacuated.
2	36	Female.	Chronic suppuration of middle ear.	Wilde's incision. Knife went through with mastoid cell.
3	18	Male.	Chronic suppuration of middle ear.	Wilde's incision. Pus evacuated.
4	6	Male.	Fistula of the mastoid.	
5	9 mos.	Male.	Chronic suppuration of middle ears; polypus; abscess of mastoid.	Enlargement of opening.
6	6	Female.	Acute suppuration of middle ear; small fistula in mastoid.	Enlarged with a drill.
7	5	Male.	Chronic suppuration of middle ear.	Enlarged with a drill.
8	2	Male.	Primary inflammation of the mastoid.	Wilde's incision. No pus.
9	6	Male.	Acute suppuration of middle ear with mastoid periostitis.	
10	2	Female.	Chronic suppuration of middle ear with mastoid fistula.	
11	48	Male.	Acute suppuration of middle ear.	Opening of the mastoid with drill. No pus.
12	20	Male.	Acute suppuration of middle ear.	Wilde's incision. Enlargement of fistula with drill.
13		Male.	Acute suppuration of middle ear.	Wilde's incision. Pus evacuated. Small fistula found, which was enlarged with drill.
14	17	Male.	Chronic suppuration of middle ear.	Wilde's incision. Evacuation of pus.
15	9	Male.	Chronic suppuration of middle ear.	Wilde's incision. Fistula in mastoid. Enlarged with drill.
16	23	Male.	Acute catarrh of middle ear.	Wilde's incision. Enlargement of fistula with drill.
17	39	Male.	Impacted cerumen with mastoid periostitis.	Leeches.
18	15	Male.	Acute suppuration of middle ear.	Wilde's incision. Evacuation of pus.
19	31	Male.	Chronic catarrh of middle ears.	Wilde's incision.
20	58	Male.	Chronic suppuration of middle ears.	Wilde's incision.
21	10	Male.	Chronic suppuration of middle ear with polypus.	Wilde's incision. No pus.
22	39	Female.	Acute inflammation of middle ear.	Leeches.



*Writer's Service at the Manhattan Eye and Ear Hospital.*

Time under observation.	Result.	Remarks.
	Unknown.	
2 weeks.	Relieved.	Deafness, with tinnitus aurium, and occasional stinging pains in the ears, appeared 4 months ago; has had no good sleep, until the operation, for 3 weeks.
	Relieved.	
	Relief.	
40 days.	Cured.	Drum-head normal.
	Unknown.	
18 months.	Cured.	Case reported in full in body of the article.
3 months.	Cured.	
	Relieved.	Operation by Dr. Ramsdell.
3 months.	Cured.	
7 months.	Cured.	
1 month.	Cured.	
1 week.	Relieved.	

No.	Age.	Sex.	Disease exciting present attack.	Treatment
23	54	Male.	Chronic suppuration of middle ear.	Mastoid opened with a drill.
24	4	Male.	Mastoid periostitis.	Leeches.
25	35	Male.	Chronic suppuration of middle ear.	Wilde's incision. Removal of necrosed bone through auditory canal.
26	48	Male.	Chronic suppuration of middle ear.	Opening of mastoid with drill.
27	24	Male.	Acute suppuration of middle ear.	Incision in auditory canal, and Wilde's incision. Pus removed.
28	30	Male.	Chronic suppuration of middle ear.	Wilde's incision. No acct. pus.
29	22	Female.	Acute suppuration of both middle ears. Mastoid periostitis.	Leeches. Poultices.
30	37	Male.	Sub-acute suppuration of middle ear.	Perforation of mastoid with drill. No pus.
31	15	Male.	Chronic suppuration of both middle ears.	Opening of mastoid with a thick probe.
32	43	Male.	Acute suppuration of middle ears.	Opening of mastoid with a drill.
33	5	Female.	Chronic suppuration, with mastoid fistula.	Enlargement of fistula.
34	2	Female.	Mastoid periostitis.	Mastoid opened through wall of auditory canal.

### *Historical Sketch of Operations upon the Mastoid Process.*

It is only three years less than a century, since a Danish surgeon, Berger, of Copenhagen, who evidently suffered from chronic non-suppurative inflammation of the tympanum, or from disease of the labyrinth, misled by the indications laid down by the surgeons of his time, died from meningitis induced by an operation for perforation of the mastoid process. "A martyr to the operation," says one of the writers of his day. Beck (*Handbuch*, p. 60) states that Berger was old and deaf, and that after the bone was opened injections would not pass through the opening into the nose or mouth. Fever, sleeplessness, vomiting, and delirium followed, and the patient died in eleven days. There

Time under observation.	Result.	Remarks.
Some weeks.	Cured.	Reported in author's text-book, page 512.
3 months.	Cured.	Erysipelas occurred. Operation by Dr. Tilden Brown. Reported in ARCHIVES OF OTOTOLOGY, vol. xii., 1883; also in author's text-book, page 522.
3 months.	Cured.	Abscesses of neck, reported in author's text-book, page 525.
15 days.	Cured.	Reported in author's text-book, page 498.
2 months.	Cured.	
51 days.	Died of pyæmia.	
3 months.	Cure.	Patient had pyæmia. Fully reported in vol. x., ARCHIVES OF OTOTOLOGY, page 41; also in author's text-book, page 544, sixth edition.
2 months.	Cure. Drum-head healed.	Erysipelas occurred.
6 months.	Cured. Drum-membrane did not heal.	
2 weeks.	Cured.	

was suppurative meningitis. Where the bone was opened it was two lines in thickness, while the perforator entered for five lines.

Like perforation of the membrana tympani, trephining the mastoid, having been successfully performed under proper indications, was widely recommended for cases for which it could do but harm, and poor Berger's life paid the penalty for a want of knowledge on the part of the surgical writers of his day. If the operation had been performed many times, in such cases as those of Dr. Berger's, there would have been many more martyrs.

A regimental surgeon, Jasser, in 1776, performed the operation upon the ear of a soldier who had suffered long

from a chronic suppuration with occasional acute attacks attended by great pain. The mastoid was swelled; the patient was half insane with pain. Jasser made an incision on the mastoid about an inch long and found a drop of pus. Encouraged by this, he cut down upon the whole length of the mastoid bone. He found the surface roughened. With a probe he went quite deeply into the mastoid cells. He injected fluid into the opening; it came out of the nose, and, at the same time, a large quantity of pus was discharged from the external meatus. The patient immediately exclaimed that the pain had left his ears. He went quickly to sleep and rested uninterruptedly for ten hours. In three weeks the opening behind the ear had healed, the discharge from the auditory canal had ceased, and the patient heard better than before. Stimulated by this, Jasser performed the same operation upon the same person, upon the other ear, from which there was no discharge, but in which the hearing was impaired. Here the hearing is said to have also been improved, although there was no caries of the bone. The operation got its name from Jasser, although, as every medical reader knows, it had been proposed by Riolanus more than a hundred years before Jasser's time, and Petit had opened a mastoid with a gouge and hammer in 1750. The first named had proposed the operation for deafness and tinnitus caused by stoppage of the Eustachian tube. Morgagni declaimed against the operation, not on good grounds, however, but because he supposed there was no opening of the mastoid cells into the tympanum. Petit, however, recommended the operation for caries and abscess of the mastoid. Jasser seems to have lost his head after his first properly performed and successful case, and he probably was the cause of the widely spread recommendations of this surgical procedure for all kinds of aural cases. If Jasser had rightly understood the indications for opening the mastoid—indications which were plain in his first case and which were not to be found in the second,—a valuable surgical procedure would not have been practically ignored by the profession for nearly fifty years. It required about this length of time before surgeons would “med-

dle with the mastoid." The operation was, however, occasionally performed by independent surgeons, when pus was evidently retained in the bone, but very few reports are found of these cases. Tröltzsch<sup>1</sup> finds seven cases prior to 1858. In the operative surgery of Sir Charles Bell,<sup>2</sup> as early as 1812, he says: "We learn from this view of the subject how carefully we ought to attend to symptoms when there is disease of the ear, lest it should become irrevocably bad, and end in communicating the disease to the brain. We must bleed and purge and foment to allay the pain and inflammation if it be active, . . . and when we can ascertain that there is caries in the posterior angle of the bone, with danger of the confinement urging the progress of the diseased action to the brain, we have to apply the trephine and penetrate into the cells of the bone." But here, as in all the writings until our own generation, there is a notable absence of any careful account of the early symptoms of mastoid disease, no one would be able from these general descriptions to diagnose and successfully treat the early stages of the affection. Dieffenbach,<sup>3</sup> in 1848, utterly condemns the operation, and agrees with Itard in saying that it should be entirely abandoned. He believes that a carious process would be increased by opening the bone. As great a man as Sir William Wilde<sup>4</sup> evidently does not understand that the bone ought to be opened under certain circumstances. He alludes to artificial perforations of the process for the purpose of throwing injections into the middle ear, or to relieve deafness in cases where the Eustachian tube had been closed,—an operation, he continues, which has long since been exploded, not only as ineffectual but positively hazardous. Although he had given a name to an incision through the periosteum of the mastoid for the relief of periostitis of this part, and although he alludes to fistulas being formed in this bone in the course of chronic suppuration, he gives no sign that there might be cases in

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<sup>1</sup> *Virchows' Archiv.*, 1861.

<sup>2</sup> "A System of Operative Surgery," first American edition.

<sup>3</sup> Tröltzsch's *Lehr Buch* Sechste Auflage, p. 499.

<sup>4</sup> Text-book, p. 363. English edition.

which it would be wise to go further than the periosteum and open the bone. Indeed, in many cases where Wilde's incision was performed, a little search would have found an opening that nature was trying to make." But the improper indications of "closing of the Eustachian tube, tinnitus aurium, deafness" were so confounded with the one proper one of retention of pus, that even Wilde could not separate them.

Toynbee had a very large experience in fatal cases of mastoid disease, and yet all he has to say upon the subject of the operation is: "Perforation of the mastoid process also suggests itself, and this operation may doubtless be performed in those cases, when the matter is pent up in the cavity of the ear, and is causing such urgent and serious symptoms as are likely, if not relieved, to terminate in death. I have never performed this operation, but I should not scruple to do so in a case in which the life of the patient was threatened."<sup>1</sup>

Good surgeons everywhere followed Wilde in his advocacy of a free and deep incision down to the bone. In this city, the late Professor Post regularly lectured upon affections of the mastoid, and often made Wilde's incision, but he also considered the operation of opening the process as one only or chiefly recommended for affections where it would be useless if not dangerous.

Prompted by a happy experience into which he entered rather timidly, Trölsch in 1861 published a paper in *Virchow's Archives* upon the subject of perforations of the mastoid, which probably did more than any other one thing, to bring the subject clearly before the profession. He there reports a case in which he had in 1858, perforated the mastoid with a blunt probe. He collected the scattered cases from the literature of the subject, and seems to have been the first writer after Berger's martyrdom who was wise enough to show that opening an ulcerated mastoid to remove dead bone, concealed pus, and secure thorough drainage, was a proper and often necessary operation. According to Trölsch's own words, although the indications

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<sup>1</sup> "Disease of the Ear," London, 1860, p. 341.

would now be considered imperative and clear, he opened the softened mastoid with fear and trembling. He says: "I went to work with uncommon care, even with dread."

Tröltsch's case was one of those that I have found more frequently than any other—that is to say, one in which a fistula had been made in the bone by the suppuration process.

Tröltsch seems to have hesitated after making a Wilde's incision. He looked up the accessible literature of the subject, and he found some cases where life was apparently saved by the operation. All the authorities, however, were in doubt about the propriety of performing it, and he continues:

"What more natural than such an operation appeared to one who had scarcely practised medicine for a year, as an affair to be well weighed, and that I treated the case with great circumspection and almost in an experimental manner." "I think," he says, "if I had not achieved my end with a simple probe, then I would scarcely have desired to act more vigorously with other instruments." But Tröltsch had been a student of the great Irishman. He had often seen him divide a red, tender, painful, and swelled mastoid down to the bone, and he imitated him in this case, and, in spite of the authorities, in two days went further, when the pus escaped and relieved the sufferings of his patient.

In February, 1862, Lawrence Turnbull<sup>1</sup> published two cases in which he made an incision down to the bone, and a third in which two months after he had opened the external tissues, he perforated the surface of the bone with a sharp hollow probe, and applied nitrate of silver freely. A month later he again broke down a part of the bone, and nineteen days later he removed a large piece of bone, which was found to be movable with the probe. This was an operation very like that of Tröltsch, although the German surgeon only waited a few days, before venturing to go into the cells with a probe, while the American delayed for two months. In spite of its exclusion from some tables, Turnbull's case belongs to the same category with that of the

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<sup>1</sup> *Philadelphia Medical and Surgical Reporter*, vol. vii., p. 463.

reviver of the operation. It was operated upon but three years after Tröltzsch's case, and only one year after it was published.

In 1863 Pagenstecher<sup>1</sup> published two cases, with some remarks upon the nature of affections requiring the opening of the mastoid. He declares the technique of the operation to be simple and easily acquired. This is an article written in a truly surgical spirit. In 1868 James Hinton reported<sup>2</sup> a case in which he perforated the mastoid cells with a trochar, the next day after he had made an incision through the periosteum. The case was one of chronic suppuration of the tympanum. Mr. Hinton speaks of fourteen cases of perforation of the mastoid for the evacuating of matter reported by various authors. Twelve he says were successful. In one of the fatal ones pyæmia occurred. He says the operation is suitable to two classes of cases: 1. Those in which the matter collects in the dependent mastoid cells. 2. Those in which caries takes place in the roof of the pyramid. He recommends the centre of the mastoid for perforation in the former case, and in the latter the upper part of it, about on a level with the roof of the meatus. His recommendations are evidently inspired somewhat by Pagenstecher's paper.

In 1864 A. B. Crosby, living in the mountains of New Hampshire, probably not knowing of Tröltzsch's writings, but perhaps having Sir Charles Bell's sound advice in mind, opened the mastoid, in three cases where he suspected the presence of pus, with a gimlet. Although this was in 1864, the cases did not get to general professional knowledge until 1873. Relief was given in all the cases. Some years after, in 1872, Dr. Agnew again opened one of these gimlet cases and found a sclerosed condition of the bone, one well known to the early writers.

By this time, 1864, the operation begins to be freely spoken of. Ludwig Mayer of Worms, Jacoby of Breslau, Follin, and others reported cases. Jacoby had a considerable experience, and wrote two or more valuable papers in the

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<sup>1</sup> *Archiv für Klinische Chirurgie*, Bd. iv., p. 322.

<sup>2</sup> *Times and Gazette*, London, vol. ii., p. 378.



*Archives of Otolgy.* He proposed instruments, gave tables, and so forth.

Schwartz of Halle, who has perhaps, performed the operation of opening the mastoid more frequently than any surgeon, first appears in the literature on this subject in 1864 (*Praktische Beiträge*, 1864), as having, some days after he had made a Wilde's incision, opened the roughened exposed bone with a probe, in the case of a child of  $1\frac{1}{4}$  years old. The bone, he says, was very easily perforated. In August, 1869, he, with Koppe, reported a case of reflex epilepsy, with caries of the temporal bone, cured by an operative perforation of the mastoid process. He used a trephine.

In 1870 Agnew of this city, at a meeting of the American Ophthalmological Society, reported the case to which I have already alluded. At the same meeting I reported two cases in which I had opened the mastoid cells through a minute fistula, in each case with a stiff probe.

To those cases was added a history of the operation which I believe was the first complete account that appears in any language since the time of Berger. In this paper I attempted to lay down certain indications for the performance of the operation. After seventeen years of added experience I do not know that I can materially alter these rules, although I have somewhat amplified them.<sup>1</sup>

In 1873 A. H. Buck<sup>2</sup> began his writings upon the subject of opening the mastoid with a report of thirty-five cases occurring in various parts of the world, six of which are his own.

In the same year Schwartz and Eysell<sup>3</sup> published an historical account of opening the mastoid with a table of sixty-three cases, seventeen of which were from his own practice. This publication of cases he has continued until the present day.

Although it seems clear to most writers, that all these

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<sup>1</sup> Transactions American Otolgical Society, 1870.

<sup>2</sup> These ARCHIVES.

<sup>3</sup> *Archiv für Ohrenheilkunde*, neue Folge, Bd., 1873.

steps have led to a point where we see that opening the mastoid process in many cases is a perfectly justifiable and a life-saving surgical procedure, the voice of specialists in this country is not quite unanimous upon the subject. The weight of authority seems to me, however, largely in favor of the operation, under the ordinary indications as laid down by the later writers. Strawbridge<sup>1</sup> said that he had seen over four thousand cases of purulent middle-ear disease in the last twelve years, and yet he had not trephined a single mastoid, nor had he seen a death, except in one child six months old, that died a few hours after he first saw the case. Dr. Theobald, *loc. cit.*, stated that his experience accorded with that of Dr. Strawbridge, although he had not seen so many cases. He had never opened the mastoid in the living subject. He had seen mastoid symptoms disappear under active constitutional treatment. These experiences, however, seem to stand by themselves. Nearly all of those who have seen many cases of aural disease have been obliged, occasionally at least, to open the mastoid. To me it seems as if the field of operation in this direction were likely to be enlarged rather than diminished. I have elsewhere<sup>2</sup> advised a thorough search for pus, and by an opening through the bone in all cases when seemed to be threatened from cerebral abscess. The only point in the subject that remains open for discussion seems to me to be the one pertaining to cases in which the only object is to secure better drainage of the tympanum, the mastoid itself being perhaps sound. No one with surgical education will deny that it should be opened when there is pus in it which has no sufficient outlet. No one on the other hand would consent to open it to fulfil such indications as those which deceived poor Berger.

I have said very little upon methods of operations, because I lay comparatively little stress upon them. Schwartze forsook the trephine at an early day and took up with chisels. In this he has many followers. I have continued to use a stiff probe and a drill. Buck continues to use the drill, while Crosby preferred a gimlet.

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<sup>1</sup> Transactions American Otological Society, 1883.

<sup>2</sup> Treatise on the Ear, sixth edition, 1885, p. 553.

For many decades, aural surgery was almost exclusively in the hands of men who were endeavoring to cure the incurable, by injecting vapors and fluids through the Eustachian tube in cases of chronic non-suppurative inflammation of the tympanum. Their results were deplorably bad. Otology was in such bad repute that no one would meddle with the ear or investigate its curable affections.

Sir Astley Cooper, after benefiting one patient by a paracentesis of the drum-head, although he failed in all subsequent attempts, filled his waiting-room with the incurable deaf, whom he speedily drove out lest they should injure his reputation as a surgeon. Thus, in one way or another, aural surgery became a true *terra incognita*, about which the most absurd tales got full audience, and in which very few capable and honest men labored. In these latter and better days the light of scientific and honest investigation has so cleared the pathways in Otology, that even if our footsteps vary here and there, we may walk in them with a fearless tread.

# A CASE OF ACUTE INFLAMMATION OF THE MIDDLE EAR, INVOLVING THE MASTOID CELLS, WITH SPONTANEOUS PERFORATION OF THE MASTOID.

By DAVID WEBSTER, M.D.,

PROFESSOR OF OPHTHALMOLOGY IN THE NEW YORK POLICLINIC, SURGEON TO THE MANHATTAN EYE AND EAR HOSPITAL, NEW YORK.

Mary H. P., aged twenty-nine, widow, was referred to me on November 17, 1886, by my friend Dr. G. R. Bourke, of this city. The patient, a saleslady in a dry-goods store, said that her ears had always been well until about four weeks previously, when she caught a severe cold in the head. She had profuse discharge from the nostrils and a sore throat, and after this had continued for a few days she observed that whenever she performed the act of swallowing she felt a pain in the right ear. After a while the ear became "sore and painful to the touch," and the tenderness extended "back of the ear and up to the top of the head." It hurt her to brush her hair. She put hot glycerine into the ear one evening, and during the night she was awakened by a noise as of something bursting in her ear, and found that the ear was running.

She at once placed herself under the care of a homœopathic physician, who treated her with pills, and forbade the use of the syringe and of local applications, and continued under this treatment with no apparent benefit until she came under my observation.

Upon examination I found her left ear nearly normal. With her right ear she could hear my watch only when in contact with the auricle (<sup>contact</sup><sub>6 6</sub>). The tuning-fork test showed that on the affected side, bone-conduction was better than aërial.

There was naso-pharyngeal catarrh with copious secretion. The

right external auditory canal contained pus, and pus was oozing from a small perforation in the red and swollen membrana tympani.

Inflation of the ear, by Valsalva's or by Politzer's method, forced pus and air through this perforation, and produced the easily recognized perforation whistle.

I cleaned the external auditory canal by gentle syringing with a warm solution of bicarbonate of soda, about a drachm to the pint, and having dried it with absorbent cotton, blew in some powdered boric acid through a quill powder-blower. I also directed the patient to use the warm douche, at home, if necessary for the relief of pain.

*Nov. 19th.*—The pain in and about the ear being worse, I directed the patient to have two leeches applied, one on the tragus and the other back of the ear.

*Nov. 24th.*—Notwithstanding leeching, douching, and anodynes, the pain and tenderness back of the ear have increased, and now, for the first time, there is considerable swelling of the tissues over the mastoid. There has been all along free discharge through the external auditory canal, and this remains unchecked.

As this condition of things seemed to point to the necessity of an early operation upon the mastoid, and as the patient's surroundings in her boarding house were such that, if operated upon there, she would lack the necessary care, I advised her to enter the Manhattan Eye and Ear Hospital. Accordingly, she did so on Nov. 26th. The next morning the swelling over the mastoid had increased; there was deep fluctuation on palpation, severe pain in and radiating from the mastoid, and a temperature of 100.5° F. As an operation now seemed to be urgently demanded, with the assistance of the House Surgeon, Dr. A. C. Rogers, the Assistant House Surgeon, Dr. R. L. Thomson, and Assistant Surgeon Dr. Frank W. Ring, I put the patient under ether and made an incision down to the mastoid about an inch in length and about half an inch from the attachment of the auricle. Before the bone was reached pus began to escape. When the scalpel reached a point opposite to the external meatus, it came upon a fistulous opening through the bone communicating with the mastoid cells. Its point sank suddenly in about half an inch beyond the level of the external surface of the bone, and I hesitated to push it in as far as it would go, lest I might wound the brain. After completing the incision, however, a probe was passed in and

carious bone could be distinctly felt in the region of the mastoid cells. This was verified by each of the surgeons assisting.

A tent was then inserted to keep the wound open and insure free escape of pus. This tent was withdrawn twice daily, the cavity syringed out with a solution of the bichloride of mercury, 1 to 25,000, and a new one inserted. The external auditory canal was also douched with warm water twice daily, and having been carefully wiped out with absorbent cotton, was filled with boric acid.

*Nov. 30th.*—A rubber drainage tube was inserted into the bony fistula, and this, giving more satisfactory drainage than the piece of tape, was removed only once daily in order to make sure that there was no impediment to the free flow of pus.

*Dec. 2d.*—The mastoid region is looking better. There is still free discharge of pus from the fistula and from the external auditory canal.

*Dec. 4th.*—The patient's health has improved under a regulated diet with porter, and her bowels have been kept open by means of Seidlitz powders. The tenderness about the mastoid is markedly relieved; also the swelling and redness are diminished.

*Dec. 14th.*—The patient has steadily continued to improve up to to-day, but now her temperature is a little higher.

*Dec. 15th.*—Temperature over  $100^{\circ}$ .

*Dec. 16th.*—Temperature again below  $100^{\circ}$ .

*Dec. 18th.*—Temperature normal. The patient showed no tendency to relapse from this time forward. The ear was occasionally inflated by Politzer's method.

*Dec. 20th.*—The fistula is healing from the bottom by granulation tissue and is crowding out the drainage tube.

*Dec. 25th.*—The drainage tube can no longer be used.

*Jan. 7th, 1887.*—The patient was discharged "cured." Back of the ear could be seen only the scar resulting from the healing of the incision. The perforation of the drum-head was healed about the same time, so that there was no longer any discharge from the external auditory canal. The hearing power was restored to  $\frac{1}{4}\frac{2}{6}$ .

While under observation the temperature was taken twice a day—at 8 A.M. and 7 P.M. On the day she entered the hospital it was  $100.5^{\circ}$ , and at no time did it rise any higher. It ranged  $100.5^{\circ}$  to normal until Dec. 17th, a period of three weeks, after which it remained normal.

In this case the inflammation of the mastoid cells came about in the usual way. There was a severe "cold in the head" and an acute inflammation of the mucous membrane lining (the naso-pharynx). This inflammation extended, by continuity, up the Eustachian tube, and thence into the mastoid cells, which constitute a part of the middle ear.

It is remarkable that there should have been sufficient penning up of the secretions in the mastoid cells to produce death of the bone and a large opening through its thick external wall in so short a time and without any apparent diminution of the discharge from the middle ear through the external auditory canal. It is also remarkable that after so severe and extensive an inflammation of the parts involved in the process of hearing so nearly the normal hearing power should have been restored.

## FACIAL ERYSIPELAS OCCURRING AS A COMPLICATION OF DISEASE OF THE EAR.

By GORHAM BACON, M.D.,

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CASE 1.—Patrick M., Irish, æt. fifty-nine, was seen Jan. 9, 1882, suffering from a suppurative otitis media, which commenced Christmas night, when the left ear first pained him. He says there was a discharge in a few hours after the beginning of the attack, and this has continued ever since. He complains at present of tinnitus and some pain over the mastoid process. He has never had any ear trouble before, and is a strong and healthy man in appearance. He has bad teeth. The discharge is profuse and mucopurulent in character.

*Jan. 27th.*—The discharge during the past week has become less and on Jan. 25th, the anti-tragus became inflamed and swollen. An erysipelatous inflammation commenced to spread from that point, and yesterday, Jan. 26th, the whole auricle (left) became involved and is now twice the size of the right one. For three or four days he experienced considerable pain in the ear. The pains behind the auricle have become less; the erysipelas now extends around the auricle, over the mastoid, and in front of the pinna. There are several granulations in the canal, which is filled with muco-pus, but less in quantity than when last seen; the walls of the canal are very slightly congested, almost normal in appearance. The drum-membrane not well made out, as a polypus in the upper portion of the membrane obviates a good view. The erysipelatous inflammation extends upwards into the scalp; tissues œdematous.

*Jan. 28th.*—The patient had a fairly good night. Inflammation about the auricle and mastoid somewhat less; he says he had a chill last night and felt a little chilly this morning. He has



some slight fever ; pulse 100. The erysipelas is gradually extending over the scalp. The patient complains of being dizzy.

5 *p. m.*—Lower eyelids involved now and the erysipelatous blush extends over the forehead ; pupils of normal width and responsive to light.

Temp.  $104.5^{\circ}$  F. ; pulse 124. The patient's mind is clear and he has no headache. The discharge has been free all day and to-night the drum-head is less congested ; no applications made to the canal to-day.

*Jan. 29th.*—The patient had a good night.

Temp.  $100.5^{\circ}$  F. ; pulse 93, strong and bounding.

Left eyelid œdematous still, but the redness is disappearing about the face, forehead, and ear ; there is some œdema in the left infra-orbital region, also behind the auricle, which is still swollen but in a less degree. The scalp is tender and red over its greater extent and pits on pressure. The pains about the ear and mastoid region have almost gone ; the discharge is thick, muco-purulent but less in quantity. The membrana tympani is much less congested and the perforation is well seen in the posterior lower quadrant ; the neck is stiff and somewhat red.

8 *p. m.*—Temp.  $102.5^{\circ}$  F. ; pulse 102 ; no headache ; left pupil dilated, but responds to light.

*Jan. 30th.*—Temp.  $100.5^{\circ}$  F. ; the redness has disappeared from the face and is gradually subsiding over the scalp but has extended somewhat down the neck.

*Jan. 31st.*—Temp.  $97.5^{\circ}$  F. ; he had a good night ; erysipelas gradually subsiding ; membrana tympani clearing up and the discharge less.

*Feb. 12th.*—The discharge ceased about Feb. 2d and the noises about the same time. The watch is not heard on contact but he hears loud voice. The membrana tympani has healed ; lower half slightly congested and the epithelium is peeling off.

*Mar. 13th.*—Since Feb. 12th there has been some discharge, but when examined to-day the canal was found dry ; the membrana tympani is still slightly congested and lustreless but is clearing up. The hearing distance is almost normal.

*Apr. 13th.*—The hearing good ; his general health and appetite much improved. The drum-head is somewhat dull, and there is some congestion along the handle of the malleus and in Shrapnell's membrane.

In regard to the treatment adopted in this case, besides consti-

tutional measures and local applications for the erysipelas, the ear was treated with pulv. acid. borac. et hydrastis canad. before the appearance of the erysipelas and when it had fairly well subsided. The granulation was cauterized with nitrate of silver.

CASE 2.—A patient, German, æt. twenty-two, butler in a private family, consulted me Dec. 28, 1883, and said that a week ago the left ear began to pain him and to discharge. He had taken cold. The pain has been principally at night; discharge slight. He has always been a healthy man; he was troubled with boils on his arms and legs a few years ago, which the attending doctor told him were due to poor blood. When very small, he had some trouble with the same ear as affected now. Last night he was dizzy and nauseated and slept but little. Hearing distance, watch, R. E. normal; L. E.  $\frac{0}{60}$ . A tuning-fork when placed on the vertex cranii is heard louder with the left ear.

*Examination.*—Right membrana tympani lustreless, retracted; cone of light very small; short process prominent.

Left canal almost occluded by a furuncle situated anteriorly in the cartilaginous portion of the meatus. Membrana tympani covered by sero-purulent fluid and pulsation in the lower part; inner end of the canal slightly inflamed. Posterior cervical gland enlarged and hard, and there is some induration of the tissues in the ante-auricular region. The furuncle was opened and some pus evacuated. Temp.  $102\frac{1}{2}^{\circ}$  F.; pulse 100.

Dec. 29th.—Temp.  $102\frac{3}{5}^{\circ}$  F.; pulse 100. He slept better than for some time. The induration in front of the auricle is to-day more pronounced, and a gland at the angle of the jaw is indurated. L. h.  $\frac{2}{60}$ . There is a perforation in the posterior and lower part of the drum-head; the discharge watery but not profuse; no pain in the mastoid; there is, however, an erysipelatous blush over the cheek, and indurated tissues in front of the auricle.

8 p.m.—Temp.  $103\frac{1}{5}^{\circ}$  F.; pulse 105. The patient got up and was around for several hours, but felt dizzy on walking; there is no pain in the ear, only in the indurated tissues.

Dec. 30th, 9:30 A.M.—He slept more during the night and feels better to-day. The erysipelas is beginning to spread, and besides involving the entire auricle, which is very much swollen, extends over the cheek and above and behind the ear. Temp.  $102\frac{1}{2}^{\circ}$  F.; pulse 102. The *Mt* is less congested and looks better; the discharge is a little more profuse and thicker; the posterior inferior quadrant of the drum-head is destroyed. 7:30 P.M. temp.  $104\frac{3}{8}^{\circ}$  F.; pulse 100.

*Dec. 31st, 9:30 A.M.*—Temp.  $103\frac{3}{8}^{\circ}$  F.; pulse 100. The erysipelas is fading where it commenced, but is spreading towards the nose and on to the left side of the forehead; there is none however below the angle of the jaw; the inflammation has extended across the nose; the left auditory meatus is closed. 2 P.M.: temp.  $104\frac{3}{8}^{\circ}$  F.; pulse 104. 8 P.M.: temp.  $102\frac{4}{8}^{\circ}$ ; pulse 100. No delirium, no headache. The erysipelatous tissues are covered with vesicles.

*Jan. 1st, 9:30 A.M.*—The patient slept but little during the night, and was restless; discharge from the ear very slight; the erysipelas has involved the left eye and has now spread to the right one; 10 P.M. temp.  $103\frac{2}{8}^{\circ}$ ; pulse 100.

*Jan. 2d.*—He had two attacks of epistaxis since last evening. Right eye closed; left one commencing to open; the erysipelas has spread over the right cheek and has extended into the scalp. Temp.  $104^{\circ}$ ; pulse 90.

*Jan. 3d.*—Temp.  $102\frac{2}{8}^{\circ}$ ; pulse 96. He had a good night and seems better to-day; redness fading, and desquamation commencing; there is some tenderness and œdema on both sides of the head.

*Jan. 4th.*—Temp.  $100^{\circ}$ ; pulse 78. The perforation is closing; some muco-purulent discharge in the canal. Right auricle swollen and tissues over the mastoid invaded; both eyes have opened, and face and forehead desquamating; the left auricle has regained its natural size; watch, L. E. 1".

*Jan. 5th.*—Temp.  $98\frac{1}{2}^{\circ}$ ; pulse 85 at noon.

*Jan. 6th, 4:30 P.M.*—He slept well last night and his appetite is improving. The soreness about the scalp is less. Urine examined; albuminous and diminished in quantity.

*Jan. 9th.*—The perforation in the *Mt* closing; there are no noises in the ear, nor have there been any at any time; urine free from albumen.

*Jan. 14th.*—The patient is about his work now, and the perforation is almost closed.

Besides constitutional treatment and local applications for the erysipelatous inflammation, the ear was treated by the so-called dry method, the insufflation of powders, principally boracic acid.

I reported these two cases at a meeting of the N. Y. Ophthalmological Society, and in the discussion which followed, Dr. Roosa mentioned two cases which are given at

length, in his treatise on the ear, in which erysipelas occurred as a complication of mastoid disease.

Dr. J. S. Prout spoke of a patient whom he had seen, Miss A. V. I——, æt. 40, Jan. 17, 1879. She had acute otitis med. dextra, following a cold and sore throat; *Mt* injected and pushed out. It was punctured, giving exit to bloody serous fluid. Later on the same day, two leeches were applied, with relief of pain. Jan. 19th, there was much pain, free discharge from the tympanic cavity; walls of the meatus (ext.) inflamed and they were incised up and down. There was a swelling in front of the tragus which was punctured but no pus escaped; the walls of the ext. meatus being still inflamed, were incised in three or four places, under partial influence of chloroform.

*Jan. 21st.*—Erysipelas set in extending across the face, later over the scalp, reaching the neighborhood of the left ear on the 24th. During this time a free discharge persisted from the right ear.

*Feb. 2d.*—Her condition in general and as to the right ear had decidedly improved, but the left ear then became painful with *Mt* giving a red reflex and pushed out by fluid; the drum-head was incised, giving exit to a small quantity of bloody fluid. In a week, the perforation in this ear was healed. The right ear continued to discharge for a few weeks longer, with a round perforation in lower posterior quadrant. In April, furuncles formed in this ear but were not incised.

*Apr. 1887.*—The perforation still persists, but the ears have given no further trouble.

Dr. St. John, of Hartford, had also had a patient in bad hygienic surroundings, for whom he had made an enucleation. Erysipelas attacked that side of the face and then went around to the other, and was followed by an otitis med. purulenta on this latter side.

At a subsequent meeting of the same society, Dr. David Webster reported the following case which he had seen a few days since. Mrs. N., of New York, æt. 69, in poor health since the middle of December, 1886, complained of vague pains in the head, which seemed to be gradually lo-

cated in the left ear, about the 12th of Feb., 1887. A discharge was first noticed from that ear. Considerable pain for the next two days was referred to that ear, together with general pains in the head, which she had had from the first, and they are still present. On Feb. 14th, in the morning, erysipelatous inflammation was first noticed on the left side of the nose and cheek, and it spread over to the right side of the nose and cheek, but never reached either auricle, never passed the angle of the face on the left side, where it spread the most. On the same day that the erysipelas first appeared, acute otitis media attacked the right ear, and a discharge followed on the night of the 15th. Under vigorous treatment for the erysipelas and the warm douche, the inflammation subsided in a couple of days, and the discharge from both ears ceased in three or four days. On the 18th, the middle-ear symptoms having begun to subside, the left auricle and ext. audit. canal became very much swollen (otitis externa) but there was no immediate connection between that and the facial erysipelas. It involved the canal very little, but the whole auricle was red, swollen, and sensitive. The patient is still troubled with neuralgic headache, although the erysipelas is well and the perforations of the drum-head have healed. The head pains are almost entirely of the nature of right hemicrania. The hearing has returned to the left ear, while with the right she can hear the watch only when in contact with the meatus.

Dr. D. C. Cocks also reported a case which he had recently seen, of erysipelas followed by otitis media purulenta.

According to some writers, erysipelas affecting the auricle may occur as a primary or idiopathic disease from cold and other causes, but more frequently it is due to an extension of the inflammation from parts adjacent to it. Leech bites sometimes cause erysipelatous inflammations as well as incisions made in the walls of the ext. audit. canal, in persons whose general health is not good. When the auricle is involved, the disease may spread to the auditory canal, completely occluding it and also causing an inflammation of the middle ear. On the strength of modern researches, it is now generally admitted that erysipelas is caused by bacterial in-

vasion of a wound, in all instances (Fehleisen's micrococcus erysipelatos). In both of my cases, the erysipelas was evidently secondary to the inflammation of the ear. The first patient had an attack of acute sup. otitis media on Christmas night, but was not seen by me till Jan. 9th. Two weeks later the antitragus became inflamed, and on the following day the whole auricle was involved in an erysipelatos inflammation and was twice its natural size, the auditory canal at the time being less congested and the discharge somewhat diminished in quantity. There was nothing in the appearance of the canal or middle ear, before the appearance of the erysipelas involving the auricle and face, to denote anything but a severe case of suppurative otitis media.

The second patient, when first seen, was suffering from acute sup. otitis media and furuncle of the canal, which had commenced a week before; the inner end of the canal was but slightly inflamed, but there was induration of the tissues in the ante-auricular region. The furuncle was opened, and on the following day an erysipelatos inflammation commenced to involve the auricle.

In both patients, their general health being below par, the erysipelas was probably caused, in the first case, by the muco-pus, which, irritating and excoriating the parts, set up an inflammation of an erysipelatos type; while in the second case, the disease undoubtedly followed the opening of the furuncle in the cartilaginous meatus, as it is a well-known fact that, in debilitated persons, erysipelas may follow the most insignificant as well as the most violent injury.

It is also probable that erysipelas of the pharynx may spread to the face by means of the Eustachian tube, tympanum, and ext. auditory canal, for Morrell MacKenzie in his work on throat diseases, in speaking of an erysipelatos inflammation of the pharynx, says that the propagation of the malady from the face to the pharynx, and *vice versa*, was observed to take place by four different routes, viz.: (1) most frequently by the lips and mucous membrane of the mouth; (2) by the nasal fossæ; (3) by the Eustachian tube, the middle ear, and the ext. audit. meatus; and (4) by

the nasal fossæ, and lachrymal sac, and ducts to the conjunctiva and eyelids. In a case reported by Gull, the erysipelas, spreading from the pharynx, reached the face almost at the same time by the auditory and lachrymal channels. In one case seen by the same author, "the affection commenced in the auricle of the right ear and spread through the Eustachian tube to the uvula and left tonsil."

CASE OF CEREBRAL ABSCESS DUE TO EAR DISEASE,  
IN WHICH THE SKULL WAS TREPHINED BY DR.  
WM. MACEWEN, GLASGOW, WITH THE RESULT  
OF REACHING AND EVACUATING AN ABSCESS  
IN THE TEMPORO-SPHENOIDAL LOBE; COM-  
PLETE RECOVERY.\*

By THOMAS BARR, M.D.,

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GLASGOW.

W. H., a boy, aged nine years, was admitted to the Ear Hospital on the 13th of January last. He is one of a large healthy family, and he had no previous illness, with the exception of whooping-cough. For about a year his mother noticed at times a slight, badly smelling discharge from the right ear. She was not aware how this discharge originated.

Three weeks before admission the boy was seized with pain in the affected ear and side of the head so severe as to prevent sleep, accompanied by a hot and dry skin, and followed in twenty-four hours by vomiting, with great drowsiness. These symptoms—the vomiting, the pain, and the drowsiness—continued for four days, during which the treatment consisted of the application of a mustard poultice to the stomach and the administration of a dose of senna. A doctor now saw the boy and prescribed poultices to the ear and powders for internal use. After four days the vomiting ceased, but the pain in the ear and head and the drowsiness still remained. A fly-blister was next applied to the skin behind the ear, and relief of the pain seemed to follow. A night or two after (about eight days from the commencement of the symptoms) he

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\* Dr. T. Barr, in sending in his MS., writes: "A portion of the report (that by Dr. Macewen) has already appeared in the *Lancet*, but the additional details given here, and the unusual importance of the case, would, I think, justify its insertion into the ARCHIVES." With this the editors heartily agree.—K.



had the first rigor, which was a severe one, lasting a quarter of an hour, during which "he shook all over and his teeth chattered and his feet were cold." Between this time and his admission to the institution he had, in all, six rigors, at intervals of about two days. He was drowsy, and frequently complained of pain in the ear and head. His bowels had been from the beginning obstinately confined.

*Condition on Admission to Ear Hospital.*—The boy had an extremely emaciated appearance, although he was before the illness and is naturally a plump boy. The face was somewhat livid. There was also a short, dry cough. During the first night he slept pretty well, and on the following day he looked better than on the one previous. The ear was now examined, and a perforation was found to exist in the upper part of the tympanic membrane, from which some purulent secretion was escaping, although the quantity was not great. There was defective hearing on that side, but the condition of the boy prevented an exact estimate of the degree of deafness.

For two days after admission there seemed to be a lull in the symptoms, no pain being complained of, although undue drowsiness was observed; after the two days, however, he began to complain of pain in the ear and head, and he had a slight rigor. There was no evidence of an acute inflammatory process or of retention of pus in the ear to account for the pain, and there was neither redness nor swelling over the mastoid process. Firm pressure, however, over the latter region elicited signs of pain, although evidently not of a severe character. The temperature at this time was  $99.6^{\circ}$ , and the pulse was 92. In view of the rigor and of the tenderness over the mastoid, I decided to perforate the mastoid process. Assisted by Dr. W. F. Somerville and Dr. F. V. Adams, I opened into the mastoid cells by chiselling through the cortex behind the external auditory canal, and succeeded in passing a stream of fluid (a weak, watery solution of carbolic acid) through the antrum and tympanic cavity, out by the external meatus, and also in the reverse direction. A small quantity of purulent and caseous débris was washed out. A drainage-tube was introduced into the orifice in the bone, and iodoform was used as a dressing. Twice a day afterward, a disinfecting solution was forced through from the opening behind to the external meatus, and *vice versa*.

The operation took place late on the Saturday evening, and for

two days no material change was noticed in the boy's condition. After that, however, a slight rigor occurred, the pain in the head became worse, and the drowsiness deepened. On the 18th a copious discharge, having a most offensive odor, suddenly began to escape from the ear. There is little doubt, from the suddenness of this discharge, that the contents of the abscess in the brain began at this time to escape partially into the ear; the odor of the discharge was quite the same as that afterwards emitted by the abscess in the brain when the skull was trephined.

On the 19th the condition was as follows: Frequent complaint of pain in forehead, which he wants to be constantly pressed with the hand. He is very drowsy, and during sleep the eyes are partially open. There is no appetite—refuses to take any food or drink. There is intolerance of light, and sticky mucus partially glues the eyelids together. The tongue is red and smooth; the pulse numbers 68, and the beats are somewhat intermittent; and the temperature is 100.6°. On the 20th, at 2 P.M., I made the following note: Temp., 99.6°; pulse, 70, and irregular. He frequently calls out: "Oh, my head; hold my head," and insists on the forehead being constantly pressed. Tapping over the right temporal region produced evident wincing. There is slight ptosis of the right eye. In moving the eyeballs there seems to be defective action of the left internal rectus. As he sleeps, the left eye is partially open. A flush of redness frequently suffuses the face. Dr. Finlayson, who saw the case on the evening of this day, notes: "Slight flabbiness of left cheek in movements. Moves both arms. No rigidity of neck. Abdomen retracted. No squint. No inequality of pupils. No diplopia, so far as can be ascertained." For the next two days he was very restless; seemed to suffer great pain in forehead, and refused to take any nourishment whatever; was emaciated as one in the last stage of phthisis, and seemed to be dying. On Saturday, the 22d, Dr. Gairdner saw the patient along with Dr. Barr in consultation, and they agreed that probably an abscess existed in the brain, and that Dr. Macewen should be called in, with the view of deciding on the propriety of operative interference. Dr. Macewen visited the patient the same evening, and was clear about the duty of trephining the skull in order to reach the abscess, which was probably in the temporo-sphenoidal lobe. The operation was performed the same evening at 10 o'clock.

The following is Dr. Macewen's description of the operation:

“On the thirtieth day of his illness Dr. Barr asked me to see a case in which he suspected cerebral abscess. The boy's state was then as follows: On approaching his bed one perceived a heavy fetid odor, traceable to the discharge from the right ear. One saw an extremely emaciated child, with a pale, grayish face, wrinkled skin, prominent cheek-bones, and somewhat sunken eye-balls. He lay in bed upon his right side, his hand beneath his head, looking as if he were asleep with his eyelids half open. His lips were livid, and on the upper one herpetic remains appeared. His tongue was red and dry. Sordes covered the teeth. When an attempt was made to rouse him, the right upper eyelid drooped, and there was a shade of passivity of the right side of the face, with a slight dragging of the angle of the mouth toward the left. The conjunctiva of the right eyelid was congested, and the lids were smeared with pus. The pupils were equal, about medium size, and responded sluggishly to the action of light. The veins over the right side of the head were congested and stood prominently out on his shaven head. Pain on percussion was elicited over the right temporal, while percussion over the head generally was calmly borne. There was no œdema about the mastoid process. The right sterno-mastoid muscle was rigid. There was no hard, cord-like feeling along the line of the internal jugular, though the external jugular was prominent. Acute pain was elicited on digital pressure just behind the origin of the sterno-mastoid, in the tissues near the exit of the vein which passes through the posterior condyloid foramen. He was in a state of stupor, from which he could only be partially aroused, and not to such an extent as to give an intelligent answer to any question. His pulse was markedly slow, 50 to 60 per minute, and was feeble and intermittent. His limbs were extremely attenuated, and there was an irregular muscular tremor over the body generally, such as one frequently finds in approaching dissolution. He had a frequent cough, with purulent expectoration, which had an offensive odor, and there were moist râles over both sides of the chest. His bowels were and had been obstinately constipated. His urine was free from albumen. It was somewhat difficult to believe that some weeks previously this boy was apparently stout and robust, and was vigorously engaged at playing football. There was a flow of excessively fetid fluid from the external ear, and as this was greater in amount than what would be likely to come from the antrum or middle ear, it was suspected that there

might be a connection between the middle ear and the intracranial cavity. There was no difficulty in concluding that this patient suffered from cerebral abscess, originating in septic otitis media. It was almost positive that it was situated in the temporo-sphenoidal lobe, and it probably had a tortuous and minute communication with the middle ear. It was feared that the lung affection was secondary to the septic absorption. The prognosis was almost hopeless, his youth being the one favorable point. Immediate operation was advised, and with Dr. Barr's concurrence it was at once carried out.

**“Operation.**—The middle ear was washed out with an antiseptic solution, and rendered as nearly aseptic as possible. The scalp and parts around the ear were carefully washed with soap and water, then they were cleansed with turpentine, and finally with methylated spirit. An anæsthetic was administered. A half-inch disc of bone was removed from the squamous portion of the temporal, at a point an inch and a half above and half an inch behind the centre of the external auditory meatus. The bone was normal; the dura mater was here slightly congested, and did not impart any brain impulse to the finger, neither was any discernible when the aperture in the skull was filled with fluid. When the membrane was opened and turned aside, the brain tissue immediately bulged into the osseous cavity and rose above its external level. The pia mater covering it was congested, and the brain substance had a yellowish-red appearance. A hollow needle was inserted into the brain in a direction which, if introduced far enough, would strike the eminence in the petrous bone above the middle ear. After it had penetrated the brain tissue for about three quarters of an inch, there was a sudden escape of foul gas, accompanied by a bubbling sound and the escape of a few bits of fluid. Evidently the upper part of an abscess cavity had been tapped, and this contained fetid gas. The needle was inserted a little further, when pus flowed out. It was of an ordinary yellowish color, and had an offensive odor. After two drachms had slowly welled away, the aperture in the brain tissue was enlarged by forceps, and portions of the brain tissue, which had become necrosed, were removed. The latter consisted of shreds, two about the size of a large horse-bean, the others that of barley grains. On their removal more pus welled away. The cavity was then washed out with a saturated solution of boracic acid. After that, however, there was still a slow oozing of pus.

along with the extrusion of minute shreds of brain tissue. It was evident that there was a considerable zone of purulent inflammation surrounding the abscess cavity, from which the pus continued to ooze. An aperture was then drilled into the base of the skull, just above the osseous boundary of the external auditory meatus, involving the squamo-petrosal suture. The dura mater was examined here, and found intact. It was penetrated, and the abscess cavity was reached. A stream of boracic lotion was passed from this aperture so as to wash out the cavity of the abscess, and it was continued until it passed freely out by the upper opening. The current was then reversed. Even after that, when the drainage-tube was inserted, an oozing of purulent fluid took place into the tube. The ear was again cleansed. Chromicized chicken-bone drainage-tubes were introduced into both apertures. The parts were thickly dusted over with boracic-acid powder, and dressed with sublimated wood-wool pads.

"When placed in bed the patient was extremely weak, but rallied after the first few hours. A marked improvement was observable during the first week. The pulse became quicker and the temperature a little higher, both good signs. The face became brighter, the eyes clearer, the eyelids free from pus, the ptosis vanished, and the mental condition improved. After the first week, though kept on restricted diet, he improved in flesh, and continued to do so at a rapid rate. The wounds were dressed about once a week, when the parts were thoroughly syringed with saturated boracic solution, the drainage-tubes being gradually curtailed, as the granulation tissue blocked them out. The softened brain tissue at the seat of the upper opening in the skull soon presented a mass of granulations, which increased in size and rose into the aperture in the bone, uniting with the layer which formed on the exterior of the skull. Soon the two became blended together, and cicatrization rapidly progressed. The chromicized chicken-bones answered admirably as drains, notwithstanding the action of the tissues, until they were renewed, the upper one after fully five weeks. They also presented the advantage over silver ones, of being easily shortened when required.

"The child put on flesh rapidly, and at the end of six weeks was quite plump."

Dr. Reid examined the eyes about the end of the fourth week after the operation, and could find no trace of optic neuritis. He was of opinion that optic neuritis could not have been present at

the time of the operation without having left some traces of its presence four weeks after.

On March 17th I examined the affected ear. There was still slight purulent secretion coming from the granulation tissue in the middle ear. The hearing power was as follows: A watch heard forty inches from the ear in normal hearing was audible at a distance of five inches and a half ( $h = \frac{5\frac{1}{2}}{40}$ ). By bone-conduction hearing was very good. A tuning-fork (C) applied to the middle line of the head was heard louder in the affected ear. Pressed on the mastoid process, the tuning-fork was heard much louder than when held near to, but not touching, the orifice of the ear. The results of these tests with the tuning-fork pointed to a normal state of the labyrinthine and nerve structures.

A month after this the secreting process, under treatment by boracic-acid powder, was completely at an end, leaving behind a dry perforation. The boy was then in an excellent state of health in every respect. Mr. Rees Price, the dental surgeon, fitted over the aperture in the bone (the upper aperture, the lower being completely closed) a vulcanite shield, which serves very well to protect the part from injury. It is hoped that complete osseous closure will ultimately take place.

It remains to be noticed that Dr. W. F. Somerville made repeated and exhaustive analyses of the urine according to the method originated by Mr. A. E. Haswell, pathological chemist to the St. Joseph's Children's Hospital, Vienna. The following notes have been kindly furnished to me by Dr. Somerville:

*"Analysis made on morning of day of operation.*—This mainly indicates three facts: 1st. That a condition of fever is present, as judged from the small amount of urine excreted in 24 hours, its high color, acid reaction, and excessive specific gravity, the abundant elimination of urea, and extractive material (this latter comprising urophœin, uroërythrin, and indican). 2d. That a process of effusion is proceeding, as shown by the marked reduction of the chlorides. 3d. That great destruction of nervous tissue is going on, indicated by the large amount of phosphates present. This is the more striking when it is remembered that in febrile states generally the phosphates are decreased. Moreover the amount of earthy phosphates, the high specific gravity and acid reaction of the urine, the marked amount of indican and traces of carbonate of ammonia tend to raise suspicion that excessive changes in nervous tissue are occurring in the brain.

*Analysis of urine passed from twelve to thirty-six hours after operation.*—Contrasted with the last analysis, the fact that the urine is lighter in color, that the specific gravity is lower (though the gravity of fluid passed in twenty-four hours is diminished—from 0.41 L to 0.35 L), and that the extractive material is diminished indicates that the fever is not so acute. The increase of the chlorides relatively to the dry residue shows that effusion is not progressing so rapidly, whilst the marked diminution of phosphates points to a lessened metamorphosis of nervous tissue.

*Analysis made seven days after operation.*—The large quantity of urine, its light color, slight alkaline reaction, and low specific gravity lead to the conclusion that all fever is at an end. Chlorides have again increased in quantity, showing that effusion is steadily diminishing. That effusion, however, is still proceeding is shown by the fact that the total amount of chlorides excreted is yet sub-normal. The phosphates are now only slightly in excess, and the destruction of nervous tissue must therefore nearly have ceased.

*Analysis made thirteen days after operation.*—The urine continues non-febrile in character. The chlorides relatively to the dry residue are now somewhat above the normal, indicating that exudation is at an end. The phosphates are relatively exactly normal, proving that no excessive changes in the nervous tissue can be proceeding.

No albumen was found in the urine at any stage of the disease, although tests were frequently applied.

# REPORT ON THE PROGRESS OF OTOTOLOGY DURING THE LATTER HALF OF 1886.

I.—NORMAL AND PATHOLOGICAL ANATOMY, HISTOLOGY, AND PHYSIOLOGY OF THE EAR AND NASO-PHARYNGEAL CAVITY.

BY A. BARTH, OF BERLIN.

Translated by Dr. JEFFERSON BETTMAN and Dr. JAS. A. SPALDING.

## ANATOMY.

### a.—THE EAR.

1. A. V. BRUNN, of Rostock. Demonstration of corrosion specimens of the ear. *Tagebl. d. 59. Vers. deutscher Naturforscher u. Aerzte*, Berlin, 1886, S. 138.

2. Dr. GUISEPPE GRADENIGO, of Padua. The embryonic relations of the ossicles and the tubo-tympanic cavity, and the morphological significance of the latter. A preliminary communication. *Centralbl. f. d. med. Wissensch.*, 1886, No. 35. Reprint.

3. Prof. E. ZUCKERKANDL, of Graz. A contribution to the comparative anatomy of the Eustachian tube. Three plates. *Arch. f. Ohrenheilk.*, Bd. xxxiii., S. 201.

4. Dr. BENNO BAGINSKY. The development of the cochlea. *Sitz. d. physiolog. Gesellsch. of Berlin*, July 30, 1886.

5. Dr. BENNO BAGINSKY. Development of the cochlea. Two plates. (Communications from the Anatomical Instit. of Berlin.) *Arch. f. microscop. Anat.*, Bd. xxviii., S. 1.

6. ARTHUR BOETTCHER. A retrospect of the more recent examinations of the structure of the cochlea in connection with



personal investigations. Two plates. *Arch. f. Ohrenheilk.*, Bd. xxiv., S. 1.

7. Dr. SIGMUND FREUD, docent of neurology in Vienna. The origin of the acoustic nerve. *Monatsschr. f. Ohrenheilk.*, etc., 1886, No. 8 u. 9.

8. Dr. GUISEPPE GRADENIGO, Jun., of Padua. The aural organ in leukæmia. *Arch. f. Ohrenheilk.*, Bd., xxiii., S. 242.

1. V. BRUNN demonstrated some corrosion specimens of the ear, obtained by using Wood's metal, macerated subsequently in a 5 % sol. of caustic potassa. He exhibited (1) casts of the ext. ear; (2) others of the external ear canal, of the tympanic cavity and labyrinth; (3) another specimen displayed a perfect cast of the mastoid antrum. The indestructible nature of the material employed, render these casts valuable for teaching purposes. Braune calls attention to a set of similar casts of the ear in the anatomical collection at Leipzig, prepared by Helferich. As the squama of the temporal bone is preserved in these, facilitating topography of the parts, he prefers the latter. Merkel recommends the use of celloidin in taking casts of the small cavities. Albrecht directs attention to the fact that the pneumatic cells of the temporal bone are rudimentary in human beings. In all probability (still noticeable in most apes) these extend along the zygoma and malar bone, and are in direct connection with the antrum of Highmore. The rudimentary state of these cavities in man will readily account for the variations in size and extent of the mastoid cells.

2. The following investigations were carried on in Prof. Schenk's laboratory. (1) The stapes of man, and of the higher developed mammals, is developed from two distinct and separate embryonic and morphological sources: (a) from the stapedia ring developed from the second branchial arch, and (b) from the lamina stapedia (plate of the stapes), a part to be dissociated from the wall of the labyrinthian capsule. (2) At a period in which the osseous structures are merely indicated by fibres and heaping up of round cells, and, at a later stage, in which cartilage is already present, the point of origin of the stapedia artery from the carotid is different, and is attributed to an altered course of the latter. (3) The hammer and anvil constitute the proximal end of the mandibular cartilage. The handle of the hammer does not represent the proximal end of the first branchial arch, it being developed at a later period, corresponding

to that of the long and short process of the anvil. (4) The stapelial ring, developed from the second branchial arch, soon loses its relation to this structure and forms an intimate connection with the derivatives of the mandibular arch. (5) The tubo-tympanic space is originally developed from the first branchial fissure and the fissure formed by the inner wall of the two first branchial arches and the lateral wall of the base of the skull. It accordingly must not be regarded as a pouching of the intestinal tract. (6) The growth of the handle of the hammer in the direction of the auditory capsule produces a temporary closure of the upper segment of the tubo-tympanic cavity. (7) These developments can be followed comparatively throughout the entire series of mammalia. The stapes of amphibia and birds represents the lamina stapelialis of mammalia, while the columella corresponds to the annulus stapelialis with the anvil and hammer. The annulus stapelialis is homologous to hyo-mandibular of the fishes.

3. The Eustachian tube of the *ORNITHORHYNCHUS PARADOXUS*, instead of being tube-shaped, is represented by a simple fissure, which connects the tympanic cavity with the slightly pouchd pharynx. In this respect it varies from other mammals, as all, so far as observation has shown, demonstrate a tube-shaped structure. Regarding the ventilating apparatus of the middle ear, this animal seems to be in closer connection with the amphibia, as the batrachia in general represent a similar condition. For further details consult the original.

4 and 5. The author publishes his investigations on rabbit embryos, and concludes that the stria vascularis is not composed of vascular epithelium, but of connective tissue, and that during the progressive development the epithelium at these points becomes so retrograded as to render its later identification very difficult. Further, that the supporting pillars are developed from two (Kölliker, Hensen), and not from one (Böttcher) cell; that the endings of the inner cells are rounded, while the outer cells send fine filaments in the direction of the basilar membrane. The organ of Corti is directly connected with the cells of the large epithelial elevation by delicate prolongations. In other respects he confirms the observations of Böttcher, Hensen, Retzius, and Schwalbe.

6. BÖTTCHER censures a paper of Lavdowski, a German abstract of which differs from the Russian original by favoring Waldeyer in a controversy between Waldeyer and Böttcher.

He further reviews the publications of Nuel, Pritchard, the elaborate treatise of Retzius, both of Voltolini's articles, and Schwalbe's text-book. He finds fault with Voltolini's method of observation and the deductions based thereon. The reviewer's observations agree with Böttcher in his following views: "The vessels under consideration penetrate from the modiolus into the lamina spiralis, and are principally distributed to the periosteum of the upper lamella. In their course toward the edge of the lamina spiralis ossea, they take on a marked radiating direction. The majority of them form a series of loops within the limbus and return to the modiolus. Another portion of them pass between the two layers of the lamina spiralis ossea, form a series of loops within the nerve tissue distributed here, after sending a few communicating branches to the vessels above. The vascular loops contained within the limbus are mostly of considerable size, and running, as a rule, in a direction parallel with the sulcus spiralis, in their distribution on the surface of the limbus, appear to be arranged in layers parallel with the latter. These wide, spirally arranged loops are mainly noticeable in two places, *viz.*, in the tissues below the origin of Reissner's membrane, and more externally on the same level in the tissue near the sulcus spiralis. The loops, however, are also found in other portions of the limbus."

Böttcher recognizes but one *vas spirale* in the *membrana basilaris* always situated below the arches formed by the arcuate fibres. In various species of animals this structure is contained within the *zona arcuata*, its exact position, however, varying in each animal. Variations are also noticeable in the various periods of development. Its first appearance is observable at the period of the development of the *scala*; it must not be regarded as an offshoot of the system of vascular loops, but as a separate, newly-formed canal forming from below upwards. In embryos its lumen is wide, but in further development it contracts and flattens out in a vertical direction, at the same time becoming a cloud in the homogeneous layer of the *membrana basilaris*. The *vas spirale* contains a lymph sheath, noticeable in dogs and cats at the end of the embryonic period. As yet, no exact description of the terminal endings of the *vas spirale* at the apex and base of the cochlea can be attempted. Böttcher considers it as a capillary vessel, presenting no anastomoses outward (*ligament. spirale*) and but a few inward (*lamina spiralis*). Occasionally a capillary

loop passes through the labium spirale, and coursing for some distance along the habenula perforata, is mistaken for a second spiral vessel. At times there is a dichotomous division of the spiral vessel, the two branches, however, uniting again in its further course.

Böttcher never observed a third vas spirale. A continuation will follow.

7. This communication of a preliminary nature, to be followed by an elaborate treatise on the subject, treats of the examination of human foetuses of from six to seven months. The results of Flechsig's new method of examination are as follows: (1) The fibrous masses of the central nervous system do not receive their medullary sheaths simultaneously, but according to a gradual well-defined succession. (2) The fibres which, in their course, in trophic and functional relations have been found to be connected with one another, receive their medullary sheaths at the same time. (3) The earlier development of this sheath is most marked in those bundles of fibres which radiate toward the periphery of the fibre region, while in the interior of this tract the central continuations and the layers of fibres which serve to unite the gray tissue are developed in a later period. (4) The medullated nerve-fibres show a contemporaneous development of the medullary sheath throughout their entire extent. Based upon these general observations, examinations of cross-sections gave the following results: Sections of the outer (anterior) nucleus of the acoustic nerve demonstrate a considerable development in its upper portion, and present a somewhat circular appearance toward its middle portion. This nucleus appears to be in intimate relation with the most inferior and external portions of the acoustic. As the characteristic appearance and staining of these fibres cannot be observed beyond the nucleus, it is taken for granted that they end here. Internally to this nucleus, a mass of fibres, the trapezoid body, extends beyond the median line and crosses with that of the opposite side. The trapezoid body is pierced by the acoustic, facial, and abducens nerves, and is in direct crossed relation with the upper olivary body.

8. Post-mortem examination of the ears of a man aged sixty-three, who died of leukæmia. The temporal bones are pale-yellow in color, osseous tissue very compact, the medulla purulently infiltrated. Both tympanic cavities are filled with a gelatinous

yellowish-red substance, which also extends into the mastoid cells. About a fortnight prior to his death, acute hemorrhagic otitis media had been diagnosed. Microscopic examination of this substance demonstrates new-formed connective tissue, interspersed with round and spindle-shaped cells and numerous blood-vessels. At several places, hemorrhagic extravasations are noticeable. Both labyrinths do not present the slightest trace of any leukæmic exudation. Even the most delicate structures of the membranous labyrinths were perfectly intact. Accordingly, it must be doubted whether the pigmented condition of these structures, so frequently described, bears any relation whatever to the leukæmic state. After a lengthy discussion the author concludes, that the case under observation, barring slight variations, in general presents a similar appearance to cases described heretofore, and that from a physio-pathological standpoint the aural complications of leukæmia are entirely different from the ocular.

b.—NASO-PHARYNX.

1. DR. HABERMANN, docent of the German University at Prague. A contribution to the pathological anatomy of ozæna simplex or vera (studies from Prof. Chiari's patho-anatomical institute). Reprint from the *Zeitschr. f. Heilk.*, Bd. vii., 1886.

2. DR. LOEWENBERG, of Paris. Priority in the discovery of the ozæna-coccus. *Deutsch. Med. Wochenschr.*, 1886, S. 446.

3. DR. BAYER, of Brussels. The change of mucous polyps into malignant tumors. *Vers. deutsch. Naturforscher u. Aerzte*, Berlin, 1886. S. 398.

4. LÖWE. The function of the labyrinth of the ethmoid. *Ibid.*, S. 402.

5. SCHWABACH. The pharyngeal bursa. *Ibid.*, S. 400.

1. An exhaustive report of the paper read before the 59th congress of German scientists and physicians.

2. In reference to articles recently published by Thost and Klamann, LOEWENBERG claims priority in the discovery of the ozæna-coccus, and draws attention to his former publications on this subject.

3. BAYER demonstrates several specimens of nasal polypi, the apex of which was the seat of a papillary tumor. Microscopical examination showed it to be a villous cancer.

4. The author shows the distribution of the olfactory epithelium in cross-sections of rabbits' noses, according to the method generally practised. He further invites attention to Jacobsohn's organ, which is also lined with sensory epithelium.

5. SCHWABACH exhibited a large series of specimens attempting to disprove Tornwaldt's, resp. Luschka's view, that the bursa pharyngea is a sac-like appendage of the naso-pharyngeal space. He, on the contrary, agrees with Ganghofner, that it is merely a fissure of the mucous membrane which nowhere penetrates to any depth, the underlying basilar fibro-cartilage being everywhere unbroken in its extent. This fissure is not always present, and in isolated cases is represented by a dimple-like depression. This latter is morphologically identical with the termination of the central fissure, and is formed by the ridges of tissue separating the central from the lateral folds or reduplications of mucous membrane. Schwabach showed a number of specimens taken from adults, and demonstrated the cavity described by Tornwaldt as a bursa pharyngea to be nothing more or less than sections of a blind canal or tunnel formed by the agglutination or growing together of the two middle furrows. He, accordingly, is at variance with Tornwaldt regarding its independence as a separate formation, and regards it merely as a central fissure existing normally, and forming an integral portion of every pharyngeal tonsil. The embryological importance of this fissure will be treated of in a future publication. In answer, Tornwaldt claims to attribute no importance to the term bursa, and that he substantially agrees with Schwabach in his descriptions, but that he had only seldom seen the central depression which Schwabach declared to be a normal condition. Further investigation was needed to decide this question. Schwabach replies that it made an essential difference whether the bursa pharyngea was a normal structure present as such at birth, or a pathological formation. In the latter case it would be improper to speak of a catarrh or of cysts in it.

## PHYSIOLOGY.

### a.—ORGAN OF HEARING.

1. Dr. ADOLPH FICK, Wuerzburg. On the mechanism of the membrana tympani. *Verhand. d. Phys.-Medic. Ges. zu Wuerzburg*, N. F., Band xx., No. 5.

2. GELLÉ. On the rôle of the sensibility of the membrana

tympani in the orientation of sound. *La Semaine Médicale*, 1886, No. 42. (See also *M. f. O.*, 1886, 389.)

3. Dr. JOSEPH POLLAK, Vienna. On the function of the tensor tympani muscles. *Wiener med. Jahrbuch*, 1886, 555.

4. YVES DELAGE. On the function of the semicircular canals. *Compt. Rend.*, Tom. ciii., 749.

5. Dr. A. LUCAS, Berlin. Physiological and diagnostic contributions to otology. *Berlin. klin. Wochensch.*, 1886, No. 32.

6. Prof. HENSEN, Kiel. Graphic exhibition of vibrations of sound. *Zeitsch. f. Biologie*, Band xxiii., 291.

7. Dr. PAUL WENDELER. An attempt to represent graphically the vibratory curves of some consonants, and of other sounds, with Hensen's speech-writer. *Ibid.*, 303.

8. Dr. P. STARKE. On the measurement of the strength of vibrations. *Philosophische Studien.*, Band iii., 264.

9. Dr. ADOLPH LINDGREN. Consonance and dissonance. Studies in harmony. *Allgem. Musikzeitung*, 1886, 38.

1. The concavity of the *Mt* and the insertion of a stiff body (the handle of the hammer) into its tissue, contributes to make this structure of almost equal value for the reception of all conceivable varieties of sound. Artificial membranes resembling the *Mt* reflect tones of varying tint and pitch in proportion to their objective strength and entirely independent of the tension or size of the membrane itself. This is why the *Mt* has no predominant tone of its own. According to FICK, the organ of hearing must be regarded as a combination of two resonating apparatuses: one, the tympanum, constructed to receive the vibrations and to transmit them in an energetic form; the other, the cochlea, to make the various components of sound act in separate localities.

2. GELLÉ was enabled in various anæsthetic patients in Charcot's clinique to convince himself of the correctness of Hartmann's assertion that the *Mt* is of importance in the projection of impressions of hearing, and in the power of orientation. In one patient with total general anæsthesia, who felt neither mechanical nor thermic irritation, he demonstrated absolute loss of sensibility in both *Mt* and meatuses. When this man closed his eyes he could not tell from which side a watch, whose ticking he plainly heard, was approaching toward the ear. Gellé also made the crucial contrary experiment in other anæsthetic patients;

whenever the individual could correctly tell the direction from which any given sound proceeded, the sensitiveness of the *Mt* could invariably be demonstrated.

3. POLLAK's experiments start from the same point occupied by Stricker in his work on speech and song. Together with a detailed discussion of previous hypotheses, and the results of experiments in regard to the normal and pathological action of the *Mt*, the author gives in an extremely readable paper the following results of his own experiments in dogs: the tens. tymp. muscle always reacts on any moderately loud sound such as singing, whistling, tuning-fork, violin, etc. The needle attached to the muscle makes a decidedly more extensive excursion for higher tones than for lower. A certain intensity is necessary to produce the reaction, but the latter does not increase in proportion to the increase of the intensity. The pizzicato gives more precise results than an even stroking of the violin strings. These vibrations of the tensor muscle are to be regarded as a reflex action [analogous to the movements of the pupil, K.], for the waves of sound must first irritate the cochlea and the central nervous system, in order to react from the latter upon the motor nerve of the muscle.

The muscle ceased to react after destruction of both cochleæ, and after division of the medulla oblongata. The same observation was made in a deaf-mute dog. On the contrary, when only one ear perceives a sound, the muscle on the other side reacts also. The vocals cause the same reaction as musical tones, "a" being the most powerful, and "u" the least. The author therefore concludes that not man alone, as Stricker believes, but dogs also can distinguish various words by their characteristic clang-tint. He does not, however, attempt to answer whether or not the tensor muscle may have other duties to perform than those which he has so carefully described.

4. DELAGE follows Flourens, Goltz, Breuer, Mach, Cyon, and others in the opinion that the semicircular canals have absolutely nothing to do with hearing. He seems to be wholly unaware of the fact that this view has more than once experienced a great deal of opposition. His brief communication amounts to this: the semicircular canals are not the special organs for the sensation of locality; they do not represent to our perceptions the three dimensions of space; they do not give rise to reflex impressions as a result of audible impressions; they do not represent



any organ of special sense which always allows us whilst moving about in space to find again our original direction ; they only indirectly produce orientation in the position of the head by connection with the movements of the eyes. But their special role (a sensitive and excito-motor role) is at one and the same time to give us information in regard to the rotations of the head, and by reflex action to summon up compensatory motions in other muscles of the eyes, the head, etc., in order by their assistance to preserve equilibrium, and to assure security in the movements of the body.

5. LUCÆ employs a short rubber tube with an inside diameter of 3 mm, which is pushed about  $\frac{1}{2}$  cm into the external meatus, and then weakly but with the greatest possible evenness inflated with the lips. This causes in the normal ear an objective and subjective noise with a fundamental tone approaching that of the small and once marked octave. This "insufflation-sound" owes its origin to the resonance in common, of the meatus, the *Mt*, and the middle ear. After removal of the *Mt*, it is of a lower pitch, but with a very firm *Mt*, or one that vibrates but little, it is higher ; it is also higher on stretching the *Mt* by Valsalva's experiment, or by contraction of the tensor tympani. Simultaneously with this latter experiment a patient who could voluntarily render his tensor tight, heard deeper tones much worse, whilst high or over-tones were apparently heard better than ever before. The sound was invariably high and whistling in those cases only, in which the examination with the probe showed that the *Mt* was either totally or excessively thickened, or considerably concave, or when the short process of the hammer or the posterior fold were extremely foreshortened, or finally when the middle ear was more or less filled with secretion. It was rare to find an increase in the pitch of the sound with simple opacifications in the *Mt* or with small calcareous concretions. The sound is rarely deepened in pitch if the *Mt* has ever suffered a solution of continuity, whilst this phenomenon is frequently noticed in cases of large and flabby cicatrices. All of these experiments consequently go to prove that depression, *i.e.*, relaxation of the *Mt* need not invariably be accompanied with disturbances of function, whilst on the contrary these are always found in elevations. In a practical and clinical point of view therefore Lucæ advises us to inflate the meatus as above suggested if we desire to decide accurately in regard to the tension of the *Mt*.

6. HENSEN has no intention in his paper of accurately describing the "logograph" as schematically represented in its older form in Gruetzner's "Physiology of Speech," but simply to point out the principles upon which such an apparatus ought to be constructed. The receptive membrane should resemble the *Mt* as closely as possible; in order to obtain the most even writing for different pitches of tone, a heavy damper, a stiff membrane, and very minute writing are the essentials. The writing is to be done on a visible smoked glass-plate, and by means of delicate splinters of glass. Wendeler employs steel pens for this purpose. The greatest elongations rarely exceed 0.2 *mm*, and therefore the curves have to be rendered visible by means of a microscopic power of 300 to 400 diameters. We need not at this place enter into any further description of the apparatus employed by Wendeler and Hensen.

In opposition to Fick, emphasis is laid on the fact, that a longer writing-lever offers greater difficulties, and no advantages at all, in comparison with shorter ones.

7. STARKE shows that we are likely to learn a great deal concerning the laws of vibration, from the method of the graphic representation and permanent fixation of waves of sound. A careful study of the appended curves is necessary in order to understand the subject thoroughly. Thus, to cite a few examples, we may mention that the curves of the vowels are nearly pure, that the curves of the consonants in each word are combined with the curve of preceding and following vowel, that the letter R appears to show intermittent curves resembling a pseudo-vibration, that M, N, and L exhibit a vowel-like curve, that S and Ch offer mixed curves, and in the highest octaves show one thousand to fifteen hundred vibrations per second. When the artificial membrane is less tense the vibrations are undeniably more extensive, but they soon become quite indistinct. Hence if we stretch the sensitive receptive membrane we obtain an extremely advantageous representation of the vowel curves, whilst the consonants are shown off much more distinctly upon a slightly relaxed membrane.

8. It is impossible to tell precisely from the researches of previous observers, amongst whom Vierordt especially may be named, whether the vibratory motion communicated to the air is equal to the energy communicated to the apparatus, or at least proportional to that energy within certain limits. A portion of the reserved energy will of course invariably be transformed into

heat. According to Vierordt, the intensity of sound depends upon a power of the height of fall, so that for the intensity we have the formula  $J = ph^e$  in which  $e$  is experimentally determined as equal to 0.6. Starke experimented with a ball held in position by an electro-magnet, and then let fall upon an ebony board by interrupting the current. On determining the exponent, he finds it to amount to 0.85, and 0.95, *i. e.*, always less than the unit. From this he concludes "that the intensity of sound is proportional to the *vis viva*." The reviewer of the *Naturw. Rundschau*, (1886, No. 31) thinks that this thesis can only be correct when by the *vis viva* we mean that of the excited movement of the air, for on the whole the intensity of sound depends in a complicated manner upon the way in which the vibrations are produced.

9. The author shows, at least so far as the piano-forte is concerned, that there are no undertones, but that on striking a note, the lower octaves, if not dampered, vibrate but partially, consequently in the same tone. On the whole, the reviewer, who is not musical, is inclined to think that the entire treatise is based more upon a philosophical and speculative foundation, than upon a physical or practical, so that those who are interested in the subject are referred to the original.

*b.*—NASO-PHARYNGEAL SPACE.

1. ARONSOHN. Experimental investigations into the physiology of smell. *Arch. f. Anat. und Phys.*, 1886, Heft iii. and iv.

2. HACK, W. Smell and the organ of smelling. A popular lecture. J. F. Bergmann, 1885.

3. HEUSNER, Dr. L. An observation on the course of the nerve of taste. *Berlin klin. Wochensch.*, 1886, p. 758.

4. R. H. FOX. The functions of the tonsils. *Four. of Anat. and Physiology*, vol. xx., part 4, p. 559.

5. VULPIAN. On the origin of the motor nerves of the velum palati in dogs. *Compte. Rendu.*, Tom ciii., p. 671.

6. SCHADEWALT. On the localization of sensation in the cervical organs. *59.te Versammlung Deutsch. Naturforsch.*, 1886, p. 400.

1. Weber's observation, that there is no sensation of smell when the olfactory membrane is brought into contact with a scented fluid, is easily explained by the fact that the water of the solution irritates the human mucous membrane too much to per-

mit the sensation to be excited. If the scented liquid is mixed with a 6-per-cent. solution of salt heated to  $38^{\circ}\text{C.}$ , it can then be smelled for about thirty or forty seconds. The sensitiveness for oil of pinks and bromine was measured at  $\frac{1}{10,000}$  mg in 1 cm of water. A sensation of smell is perceived, no matter whether the air passes through the nose from front to back, or *vice versa*. The sense of smell for a great many substances is generally blunted within a few minutes. After examining various scented stuffs, the author comes to the following conclusions: various qualities of smell affect various regions of the olfactory nerve in such a way that one class of odors excites one district to a maximum degree, a second to a less degree, and a third not at all. Finally the author attempts to prove that all the elements are odorless. Phosphorus, sulphur, chlorine, bromine, iodine, etc., form combinations in the air or in the nose with carbonic acid or hydrogen, and it is not until so combined that they excite a sensation of smell.

2. A patient, suffering probably from tuberculous disease of the base of the brain, complicated with an abscess, was observed to display paralysis of the first and second branches of the trigeminus, whilst the third branch, together with the facial nerve, was intact. In this case there was loss of sensation and taste on the tip of the tongue. An autopsy could not be obtained.

3. VULPIAN experimented on five dogs, exposing in the cranial cavity and irritating mechanically and electrically there the origins of the trigeminus, facial, auditory, glosso-pharyngeal, pneumogastric, and spinal-accessory nerves. He obtained the same results as Chaveau in the horse and ass. None of the motor fibres of the soft palate rise from the facial or trigeminus. The glosso-pharyngeus offers perhaps a few motor fibres for the *Musculus staphylinus*, yet irritation of this nerve produced motion only in the velum of a single dog. The real root for motor fibres of the soft palate is to be sought for in the inferior radicle-fibres of the pneumogastric and in the superior fibres of the spinal-accessory nerve. It is also quite possible that these fibres all belong to the spinal nerves or to the accessory of Willis.

4. The capacity for localizing sensations in the cervical organs is extremely defective. Almost every perception in these organs is generally located erroneously. Thus irritations in nearly all districts in this neighborhood (no matter whether in the posterior nares or in the naso-pharyngeal space, etc.), are usually re-

ferred to the anterior portion of the neck (laryngo-tracheal region). This peculiarity of the cervical organs finds its analogy in the urino-genital tract, and is the cause of various pathological sensations (paræsthesias) being referred to as a whole from the region of the posterior nares into the laryngeal and tracheal tract. This condition depends, therefore, upon an erroneous judgment of the place of irritation, and not upon any reflex action, as physiologists have so long assumed.

## REVIEWS.

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**Text-Book of the Anatomy of the Organs of Special Sense.** By Dr. G. SCHWALBE, Professor of Anatomy in the University of Strasburg. Second part, second half, with 52 wood-cuts. Published by E. Besold, Erlangen, 1886.

Reviewed by Professor S. MOOS.

We have already spoken of the first half of the second part of this text-book. The second half now lying before us worthily completes Professor Schwalbe's text-book of the anatomy of the organs of special sense—*Finis coronat opus*.

The literary references and the utilization which the author has made of the same extend to the middle of the year 1886, and as Professor Schwalbe has endeavored particularly to keep in mind the needs of the specialist in a practical point of view, our colleagues everywhere will obtain abundant instruction from a careful study of the present portion of the work.

After describing the nerves of the cochlea and their terminations, as well as the ductus and sacculus endolymphaticus, the vessels of the inner ear, its veins and lymphatics, the sound-conducting apparatus is next mentioned. (1) The ectodermal portion of the vibratory tube; the auricle and external meatus. (2) The *Mt.* (3) The *endodermal* portion; viz.: the tympanum, ossicles with their muscles, ligaments, and articulations, the mucous membrane of the tympanum, the antrum and mastoid cells, and the Eustachian tube. The work terminates with a review of the vessels and nerves of the middle ear.

The reader can easily see from the terms *ecto-* and *endo-dermal portions*, that the author has again followed the **ontogenetic** theory, and the result is that the representation and the study of the organs in question gain wonderfully in clearness and brilliancy. But the book must be studied, and for that very reason we shall

simply limit our notice to the brief mention of a few of the most important topics.

Schwalbe opposes L. Meyer, and ranks himself at the side of Lange and Darwin, so far as Darwin's "Protuberance" on the helix is concerned—the *Spina, sive Tuberculum Darwinii*—to which the latter's attention was called by the sculptor Woolner, and which appearing as it does in various mammals and also in apes, has been accounted for by the eminent evolutionist on the theory of "atavism."

The author asserts with Bezold, that the shape of the external meatus, as seen in numerous horizontal sections and casts, is on the whole like that of an "S."

All measurements of the cartilaginous and osseous meatus are started, in agreement with Bezold, at the anterior tragus plate, because he believes that this plate really belongs to the walls of the meatus. The consequence is, in opposition to v. Troeltsch who started his measurements from the posterior margin of the entrance of the external meatus, that in Schwalbe the cartilaginous meatus is longer than the osseous. According to Bezold, the proportion at the anterior and the inferior wall, is as 21.18 to 14.05.

Particular attention is paid to the anatomical relations of the external meatus: the **anterior** wall—according to Sappey, the temporo-maxillary—in its relations to the articulation of the inferior maxillary bone. The **inferior** wall—Sappey's parotid wall—lies throughout almost entirely in contact with the deep process of the parotid gland. The **superior** wall—the cranial wall of Sappey—is partly overtopped by the tympanum, particularly behind the mastoid antrum, and in the whole of its bony portion separated by a bony plate of  $\frac{3}{8}$  mm thickness from the median cerebral fossa. The **posterior** wall—mastoid wall of Sappey—is only separated from the mastoid cells by a bony lamella  $\frac{1}{2}$  mm thick. The transverse sinus of the posterior cerebral fossa is but 12 mm distant. The mastoideo-tympanal fissure is often seen in the latter in macerated specimens.

This section is followed by an account of the excessively different conditions of the meatus in the new-born, the development of the inferior, anterior, and of a portion of the posterior wall from the **annulus tympanicus**, the evolution of the os tympanicum, and its peculiarities, the defects in ossification, the relations of the lumen of the external meatus in infants, the finer structures of the cuticle of the meatus, vessels and nerves, the auricle and mastoid process and external meatus, and lastly the lymphatics.

Next we have, and, as I believe, more exhaustively treated than in any other text-book, a detailed description of the *Mt* in its anatomical, physiological, histological, and comparato-anatomical relations, as well as of its several layers, its blood-vessels, lymphatics, and nerves.

In regard to the **capillary meshwork** at the margin of the mucous layer (as set forth by Burnett and myself), or meshwork-like capillary vessels curving about upon themselves, the author is of the opinion, that these correspond to the shaggy or papular-like prominences of the mucous membrane discovered by Gerlach. Nevertheless, after renewed and repeated examination of my preparations, which are still in an excellent state of preservation, I cannot assent to this opinion, and all the less since the meshwork in question has also been noticed along the handle of the hammer. (See my paper on this topic in these ARCHIVES, vol. vi., pp. 582 and 594.

Under the section of the **endodermal portion of the sound-conducting apparatus** are described the tympanum, its form, topography, and walls, the ossicles, their articulations with one another and with the tympanic walls, and particularly the close connection of the hammer with the *Mt*, and of the stapes with the fenestra ovalis ; finally the ligaments and muscles of the ossicles, the mucous membrane of the tympanum, its bridges, folds, inlets, and pockets, as well as the finer structure of the tympanic mucous membrane, together with its blood-vessels, lymphatics, and nerves.

The account in this section of the separate walls of the tympanum, and of their topographical relations, is of especial value to the practising aurist.

In his statement of the development of the ossicles, the author narrates with especial accuracy that of the stapes, and amongst its rare varieties that of the so-called columella-formation. At this point I will go so far as to refer the cases described by Steinbruegge and myself under the titles of "On the combined occurrence of disturbances of development and rhachitic alterations in the ears of a Cretin," and "On bilateral absence of the entire labyrinth," in these ARCHIVES, vol. xi., 1 and 236. In both of these we found the body and head of the stapes represented by a rod-like structure with a slipper-shaped transverse section, and in the second case the anatomical conditions, so far as the historical development was concerned, were such that we could not



assent in this case to the opinion of Parker and Gruber (to which, by the way, Schwalbe also agrees), that the stapes is developed from the labyrinthine capsule by cellular proliferation. This condition, on the contrary, seemed rather to favor the independent development of the stapes from the second branchial arch.

The last section is devoted to a description of the Eustachian tube. The author thus expresses his opinion upon the much-discussed question of the condition of this canal whilst in a state of rest : " No matter whether the osseous orifice of the portion of the tube terminates precisely at the isthmus, or extends a little further below the cartilaginous hook, at all events all anatomical and physiological observations up to this time agree in this, that the larger portion of the cartilaginous part of the tube is not patent in a state of rest, but represents a closed vertical fissure, which every now and then is opened either by the **simultaneous** action of the tensor and levator veli palatini, or by the **independent action of the former alone**. Nevertheless, the orifice may also be opened independently of the act of swallowing, by the sole action of the tensor.

The method in which the levator acts is explained by assuming that in the pharyngeal region of the tube its belly is thickened by contraction, and that thus the membranous floor of the tube is raised, and the walls pressed apart. It is impossible for the contraction of the corresponding muscular fibres in the posterior superior portion of the tube alone to enlarge the orifice of the tube, for they will rather elongate the capillary vertical fissure, pull out the folds on the mucous membrane of the floor, and thus fix that portion of the tubular wall.

With the description of the ostium pharyngeum tubæ, a short comparato-anatomical sketch of the muscles of the tube, the structure of its cartilage, the folds of its mucous membrane, as well as a retrospect of the nerves and vessels of the middle ear, and finally with otological literary references, this work terminates ; a book, rich in excellent illustrations, and one most warmly to be recommended to our fellow-practitioners from a scientific as well as a practical point of view.

**Types of Different Forms of Deafness Graphically Represented**, according to the results of various hearing-tests with tuning-forks of varying pitch. By Dr. ARTHUR HARTMANN. Fischer, 1886, Berlin.

Reviewed by E. Schulte, Milan.

The hope expressed by the reviewer on the publication of his preliminary communication (*Deutsch. med. Wochens.*, xv., 1885) on the graphic representation of hearing tests with the tuning-fork, that by means of this new method a visible, easily-comprehensible picture of any existing degree of deafness might be obtained, has not been unjustified, as the paper now before us testifies. To tell the truth, our hopes have been wholly realized, in this recent work, showing as it does the various types of numerous forms of deafness, as discovered after long and careful individual investigation, the results of which the author has registered according to his method. The remarkably striking and constant relation between the results of tuning-fork tests so obtained and registered, and the different forms of deafness so apparent at the first glance at the plates, ought sufficiently to incite every reader to investigate the question for himself and to form his own opinion. For this purpose the table for the hearing-tests, as well as the accompanying diagrams, will be very welcome.

**Atlas of Otoscopic Pictures of the Membrana Tympani.** By Prof. K. BUERKNER. With fourteen plates chromolithographed from the author's original sketches, by Adolph Giltch. Jena, 1886.

Review by GOTTSTEIN.

No one in our day will doubt that a correct interpretation of the pathological alterations in the *Mt* is the prime necessity in the recognition of diseases of the ear. The accuracy needed for this knowledge the beginner can largely obtain by the frequent otoscopic examination of patients. Nevertheless, experience teaches us that in clinical cases it is almost impossible to make the learner understand what he is seeing or what is going on, unless some drawings are at hand. The teacher cannot get along without board and chalk if he hopes to make the appearances in the *Mt* comprehensible to his scholars. Burckhardt-Merian's charts for delineating the condition of the organ of hearing supplement this need in a useful and enlarged manner. More valuable than these, however, are pictures, which reproduce the manifold tints and shades which the skilled observer can discover from pathological alterations in the *Mt*. Most German textbooks on otology make a shift without the help of illustrations. Politzer's "Wall Plates" have long since disappeared from the

book shops, and Buerkner therefore felt that he would be filling a want if, upon the foundation of some water-color sketches, which he had in the course of years thrown off for otoscopic instruction, he built up for the general benefit of the profession at large a chromo-lithographed and systematically arranged collection of pictures representing the most important typical affections of the *Mt*.

We unreservedly acknowledge the necessity for these pictures, and gladly take this opportunity of thanking the author for so successfully accomplishing his great task. There are eighty-four sketches on fourteen plates (only forty-eight in Politzer's collection), and the most experienced aurist will hardly fail to find somewhere within the atlas an illustration of every pathological condition of the *Mt* that he is likely to have seen. The drawings throughout betray the careful observer, and the chromo-lithographic reproduction, considering the enormous difficulties in the way of exhibiting objects so rich and varied in tints and shades, may truly be regarded as highly successful. Of course, if any one attempts to learn otoscopy wholly or largely from this (or any other) atlas, he will fall into many an error, despite any explanation that may be added in the margin, and the author does not by any means recommend his work as a self-teaching affair, but solely as an assistance for comparing with the drawings the alterations perceived in the objects examined, and thus for obtaining more accuracy in the recognition of various anomalies. As the atlas does not render a text-book indispensable, the author has limited his notes to a short description of each picture. An excellent index greatly facilitates the finding of various sketches of the *Mt*, intended to represent any particular pathological alteration.

We are convinced that the atlas will soon become an indispensable necessity to the clinical lecturer, and to the practising aurist a most desirable counsellor in many a difficult case of diagnosis of the true condition of the parts; and we can only hope additionally that the general practitioner who neither abandons his aural patients to their fate, nor sends them to the nearest aurist, will busily make use of the atlas, in order to accustom himself to the accuracy that is needed in this method of observation and diagnosis.

**A Practical Manual of Diseases of the Nasal Fossæ, and of the Naso-Pharyngeal Space.** By Dr. E. J. MOURE.

With fifty-three illustrations in the text, and four lithographic plates. Paris, Doin, 1886.

Notice by Dr. Arthur Hartmann.

Moure's book depicts the diseases of the nose and naso-pharynx in a compendious fashion. The author has done nothing more than to collect the most important points that the practising physician will be most likely to need. The book contains simply a copy of the views at present prevalent, and does not advance any important or novel theories. The collection can be regarded as a success from the standpoint of the purpose for which it was intended, and it may really be of use in interesting and urging to further study those who at present stand on the threshold of this interesting branch of medicine.

**The Diagnosis and Treatment of Diseases of the Ear.**

By OREN D. POMEROY. *Second edition revised, with additions.* D. Appleton & Co., New York, 1886. Price, \$3.00.

**A Clinical Manual of the Diseases of the Ear.** By LAURENCE TURNBULL. With a colored lithographic plate and numerous illustrations on wood. *Second revised edition.* B. Lippincott Company, Philadelphia, 1887. Price \$3.00.

**The Diseases of the Ear and their Treatment.** By ARTHUR HARTMANN, of Berlin. Translated from the third German edition by JAMES ERSKINE, Glasgow. G. P. Putnam's Sons, New York, 1887. Price, \$2.75.

Reviewed by H. Knapp.

POMEROY'S book, the first edition of which appeared in 1883, appears now as a handsomely gotten up volume of 413 pages with 100 illustrations in the text. It is a thoroughly American book; the practice followed and recommended, and the literary sources used, are predominantly those of this country. Yet the Europeans have not been slighted, the author being over-scrupulous in giving credit. To quote an example: page 33. "Urbantschitsch states, in his work on the ear, that in some elderly people with normal hearing the bone-conduction is defective [Politzer]." Pomeroy might have omitted both authors without doing injustice to either. His book is written with a great deal of industry and circumspection; the style is easy and clear. The chief feature of the work is the constant aim at being useful to the practitioner. From this point he describes the symptoms of each disease, illustrates them by numerous, very numerous, cases taken from his own practice

and from literature, and dwells on the details of treatment and operations. The book will be read with interest and profit by the aural as well as the general practitioner ; for the medical student it is too long.

TURNBULL'S work—567 beautifully printed pages, profusely illustrated, heavy paper—has sold so large a first edition as 1700 copies. It has peculiar features. The first is a disconnected arrangement of its subject-matter. It is not an orthodox school-book, proceeding from the external ear through the tympanum and inner ear to the auditory centre in the brain in a systematic manner, but it is rather a collection of essays on kindred subjects.

The second peculiar feature is the liberal use of the quotation marks. What percentage of the whole text the part so ornamented constitutes, I have not computed. If this remark should, however, induce somebody to believe that the book lacks originality, he would be greatly mistaken. There are, in this book, a great many most valuable observations and suggestions personal to the author, and they have been extensively quoted in otological literature. All persons that pay more than a passing interest to aural surgery will be amply rewarded by reading Turnbull's book, which gives full information on some important subjects that are scarcely mentioned in others.

HARTMANN'S work is a school-book and an excellent one. It is clear and concise, leaving out unessential matter but nothing that is of scientific or practical interest. It is brought down to the latest stand-point of aural science and art. It is thoroughly systematic, and though it bears the stamp of the personality of the author—whose scientific attainments and large experience are manifested on every page by the precision of his descriptions and the forcibleness of his statements,—it fairly and impartially represents our total stock of knowledge in this department. Here and there the author dwells too long on subjects of personal predilection ; for instance, the testing with tuning-forks of different pitch, leading him to the assumption of four different types of ear disease, illustrated by diagrams of auditory acuteness, receives too much space in a book destined for the student and general practitioner. The book has 283 pages ; is excellently well printed on handsome paper, and the translation is both faithful and perfectly English. Though there is a galaxy of text-books on otology, Hartmann's is sure to be as great a favorite with the English-American student as it has proved with the German.



## ARCHIVES OF OTOLOGY.

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THE OTOPHONE, ITS HISTORY, WITH A DESCRIPTION OF ITS VARIOUS FORMS, ITS USE BY THE DEAF, ITS VALUE AS AN AID TO RESTORATION OF HEARING, AND IN THE INSTRUCTION AND DEVELOPMENT OF HEARING AND ARTICULATION IN THE DEAF-DUMB.

By J. A. MALONEY, WASHINGTON, D. C.

SOME years since, while experimenting in the field of acoustics, the thought occurred to me that a new field might be opened for relieving the deaf by constructing the agent of relief to meet the requirements of defective audition in each case as nearly as possible. To that end, after study of the anatomy and physiology of the ear, together with such light as the limited literature upon "Physiological Acoustics" afforded, I commenced my labors in "Aural Mechanics," with a mode of procedure as follows:

1st. To develop instruments as far as I could to meet the various phases of defective audition;

2d. To construct the instruments to give satisfactory results without entering the auditory canal;

3d. To use artificial drums or membranes to guard against impact of air upon the *membrana tympani*, and prevent reverberation or disagreeable resonance so common in all the old forms of instruments.

I decided that a scientific instrument should possess these three essential qualities: It should be large enough to be of practical value; it should augment sounds; but with such augmentation the timbre or quality of sound should be preserved.

The augmentation and clearness must be to the extent

that the person will hear every word spoken, instead of a word here and there, as heretofore, which involves a severe mental strain to construct the incomplete sentence.

We are all aware that the *membrana tympani*, unlike other stretched membranes, responds to all vibratory motions within a certain limit, whether they are in the form of noise or of composite tones, transmitting, through the intermediate agencies of the middle and inner ear, to the nerve of hearing auditory sensations. Could a stretched membrane be arranged that closely imitated in function the one given to man?

After experimenting twelve months I adopted the form of membrane which is here presented. See figs. 1 and 2. The reasons for its adoption came about in this way: In the early stage of my experiments I invariably found a lack of clearness of tone, until one day the thought occurred to me that I could secure uniformity of tension by clamping the membrane between two rings. When this was done I found it a great improvement over all other methods, and consequently adopted it after thorough tests. Even after obtaining good results I could not but feel that there must be some other result produced by the rings than that of maintaining a uniform tension of the membrane. I found that while the membrane was upon the stretcher-frame, with the rings glued upon each side of it, like any other membrane, it would be thrown into sympathetic vibrations by tones corresponding to its fundamental; *but that when cut from the frame*, and dependent for its tension upon the two rings alone, it did not exhibit excessive sympathetic vibrations of its own fundamental, but was very sensitive to composite tone vibrations. Now it has been thought that the last-named feature exhibited by the *membrana tympani* was produced by its union with the auditory ossicles. But may it not be due to two facts? 1st. That the margin is thickened; 2d. That the middle layer, or *substantia propria*, is fixed to a ring of bone.

The instruments are known as Nos. 1, 2, 3, No 1 being used simply to render clear and distinct all sounds to those partially deaf. No 2 is a small instrument, and is fastened



to the auricle by a locking device, kept in place by the *tragus*, *antitragus*, and *concha*.

No. 3 is used by those extremely hard of hearing, and also as a restorative agent by means of exercise through the natural means, *i. e.*, the voice, which at the same time (by reason of clearness of tone) overcomes the sluggishness or dulness of the "percipient tract." This form is intended for use in the education of the deaf-dumb.

The following cases will give results from use of instruments :

Mr. C., aged sixty-five, while in Washington called upon me and said he had always had difficulty in hearing, but more so of late years. Upon examination I found malformation of auricle, the space between *helix* and *tragus* being very narrow and the *concha* very shallow. The person could hear an ordinary tone

Fig. 1.



Fig. 2.



about four feet away. Upon placing one of No. 2 in each ear (being made to suit the shape of each ear), he was able to hear the same tone at a distance of twenty-five feet.

Mr. M., aged forty-seven, could not hear at a distance of three feet ordinary conversational tones. I found malformation of auricle. Upon making and fitting a pair of No. 2 arranged to suit his tone defect, he could hear distinctly a conversational tone a distance of thirty feet.

Mr. H. H. F., of Philadelphia, aged fifty (sent by Dr. S. Weir Mitchell), I met at the office Dr. Chas. H. Burnett in Philadelphia. He was very despondent, and I found that an ordinary tone spoken at the meatus by Dr. Burnett could not be heard. Upon applying a No. 3 otophone he heard every thing said in a very low voice, and without any difficulty could distinguish between B, P, and T, much to the surprise and joy of the person, who exclaimed : "Why, with this, every sound comes to me clearly and naturally ! Heretofore I have had to go to the words without much success."

Mrs. G. P., aged sixty-five, could hear loud tone close to meatus. With instrument could hear conversational tones clearly and with relief to members of her family, who had difficulty in making themselves heard with old forms of instruments.

Mr. M., eighty-five years of age. The following is from the physician who ordered an instrument : " His eighty-five years sit more lightly upon his aged body. In fact it has opened up a new world to him."

Mrs. McC., aged fifty, had used all kinds of instruments prior to use of No. 3. Her physician reports it a comfort to her family and improvement to patient by its use.

Mr. G. W., aged fifty-five, extremely hard of hearing for twenty years, could hear a loud tone when spoken close to meatus. Finds the instrument a great assistance, and in thirty days could hear a low tone eighteen inches from meatus without instrument.

Dr. J. H. B., aged thirty-two, presented himself for test at the meeting of the Medical Society of the District of Columbia, May 4, 1887. Could not hear a loud tone close to meatus on right side. With instrument could hear every word spoken in a low tone. Commenced to exercise that side. He is now able to hear a conversational tone at a distance of fifteen feet without instrument.

C. H. M., aged forty-five. An engineer retired from U. S. Navy by reason of deafness. Had been using No. 3 Otophone four weeks when he wrote : " It is helping me."

The following will show results upon the deaf-dumb, produced at the Pennsylvania Institution for the Deaf and Dumb (Philadelphia) at the suggestion and under the supervision of Dr. C. H. Burnett.

*a.—Congenital Deafness.*

(1.) Ida B., aged twenty-one years. Has a deaf brother. She cannot read the lips. Has been eight years in the institution. The vowels were repeated to her three times in succession through the otophone, first at the right ear. She noticed a difference in the sounds, but could not indicate which vowels were being repeated to her. The left ear was then tested, and she indicated O twice, correctly, and noticed when the ear-piece slipped below the meatus, and so informed us. With this case test-words were

also employed, these being Philadelphia, Mississippi, Burlington, written and then pointed out to the pupil during their repetition. She indicated Mississippi and Philadelphia, and then Mississippi, again and again, when it recurred in the testing, but failed to get "Burlington."

(2.) Emma R. K., fifteen years old ; has deaf parents and a deaf maternal uncle ; also a brother a deaf-mute in the Institution. She has been four years in the school. She perceived sound by the otophone, and said, after the vowels were repeated to her three times, that A and U are different. She indicated correctly A, O, and U, missing, of course, a number between the successful replies.

(3.) John K. (brother of the previous case), sixteen years old ; heard sound in right ear through the tube, but failed to indicate correctly, after the testing by five vowels. Three vowels were then tried, viz., A, E, and O. He said they all sounded alike excepting E, but he indicated correctly O. No results in testing left ear. The word-tests were then employed, as in the previous case. Successfully indicated "Mississippi" and "Burlington." "Missouri" was now added to the word-tests, and "Missouri" was successfully indicated three times in succession. Of course there were numerous misses, but the successful indications were manifestly not guesses.

(4.) James P., seventeen years old ; *parents both mutes, father a congenital mute, the mother such by acquisition. He has also two congenital mute sisters, a deaf uncle, and a deaf aunt.* He perceives the sound of the word, Halloa ! through the otophone, and says it is disagreeable, but does not hurt. The five vowels were first tried in this case, with the left ear. A and O successfully indicated, E mistaken for U and I. The right ear was then tried, and A, I, O, and U were indicated. The word-tests, the four words already employed, were then repeated to him three times, and they were all correctly indicated. So striking was this result that Mr. Crouter, the Superintendent, felt that in one who was supposed never to have heard, it must be successful guessing.

(5.) May S., fifteen years old, sister of case 1. Has been in the Institution four years. Tried three vowels, A, E, and O, three times repeated in the right ear, and pointed out to her at the same time. She pointed out successfully, when repeated, O several times, and A and I mistaken for E. Left ear, A and O a number of times successfully indicated. The word-tests were then employed in the right ear, the four already named being repeated

three times in succession. Then when the pupil was requested to indicate what was repeated, she succeeded in indicating Philadelphia, Mississippi, Burlington, and Missouri, a number of times correctly.

The vowel O, was once understood by her as *boy*. *Boy* was then written and repeated to her, being at the same time pointed out to her, and when given among other test words, it was correctly pointed out by her each time.

*b.—Acquired Deafness.*

(6.) Mary J. McD., nineteen years old, no deafness in her family. She became deaf at four years of age, after she had learned to talk ; but has since lost the ability to talk. With the right ear does not distinguish the vowels. In the left ear she says they "sound loud." The vowels were then repeated and pointed out to her three times, as already described. She got O, several times, then A, I, O. Word-tests, *papa, mama, baby, boy*, were then employed, and she successfully indicated *mama, baby, and papa*.

(7.) Annie S., seventeen years old, became deaf at four years of age. No deafness in her family. She once spoke German, her mother-tongue. O was perceived correctly by the left ear ; she "feels it a little in the right ear."

(8.) Sarah E., nineteen years old, became deaf at three years of age. Has no deaf relations. The vowels A, I, and O, were first used as tests. She indicated successfully, O, A, and I, repeatedly by the left ear. In the right ear, I and O were said to sound alike—O was heard best, I next, and A, third.

(9.) Geo. L. H., aged seventeen years, became deaf at the age of three and a half years, after he had learned to talk, but since has lost the ability. Has no deaf relations. He says he feels the sound in his left ear. First tested with an A, I, and O ; all successfully indicated. Then tested by means of A, B, and O. He successfully indicated B, A several times.

(10.) George G., eighteen years old, became deaf from measles at four years of age, after he had learned to talk. Perceives sound "just a little" through the instrument.

(11.) Harvey De L., nineteen years old, became deaf at the age of five years, from spotted fever. He perceives a little through the right ear.

(12.) Oliver E., eighteen years old, became deaf from a catarrh at six years of age. Can speak. In the right ear "feels"

the vowels a little. Indicated correctly three times A and I. No word-tests, like those previously used, were employed, as the results with the vowels, in the cases of acquired deafness, were not as good as in the so-called congenital cases.

*c.—Semi-mutes.*

Tests were made in the cases of two boys with acquired deafness and instructed like mutes ; but still able to talk, and to hear some.

(13.) Benj. G., seventeen years old, became very deaf at nine years of age, probably from a purulent process, as indicated by the *membrana tympani*. This boy heard every thing said to him through the otophone, and returned intelligent articulate answers to all the questions.

(14.) Thos. O'B., aged eighteen years ; became deaf at the age of four years, from spotted fever. He hears very well by means of the otophone.

The articulation in such cases could, without doubt, be greatly improved by the use of such an instrument, if its employment as a means of instruction could be begun early in life. Also the function of hearing could be better retained and perhaps improved by the normal exercise it would obtain by hearing through the otophone.

The following tests were made at the National Deaf-Mute College, Washington, D. C., under supervision of Dr. F. B. Loring, and in the presence of Dr. Gallaudet and Profs. Gordon, Denison, and Ballard. The tests were made with an otophone No. 3. The following is from the report of Dr. Loring :

The method used was to write five vowels on a piece of paper which was placed in the hands of the person being examined ; then the particular vowel spoken through the otophone by Mr. Maloney, was pointed out by Mr. Wight. This was repeated three times in order to impress the different sounds of the letters upon the ear. The pupil being then required to point to the vowel given—two consecutive ones at no time being used. Words were also written in the same way, viz., "Mississippi," "Baltimore," and "New

York." The number of vowels in some cases was, however, reduced to three, as five were found to be too many to be carried in the memory of the deaf and dumb, as it must be borne in mind that names and letters convey no impression to the 'deaf-mute, and that he is not by any means on the same footing as a "hearing person" (as they themselves express it) who has lost hearing late in life. In other words his ear may recognize distinctly the different sounds as given through the otophone, while his memory entirely unpractised as regards sound may not be able to refer it correctly to the vowel indicated.

The tabulated result of the thirteen cases was as follows :

CLASS I.—*Congenital.*

W. A., age seventeen ; distinguishes five vowels correctly after they have been repeated four times.

Mr. S., age twenty-three ; distinguishes all vowels.

Mr. O., age sixteen ; repeats three vowels ; cannot carry five ; also distinguishes between " Mississippi " and " Baltimore."

L. S., ten years ; no improvement, and complains of pain.

Mr. T., age twenty-four ; can recognize three vowels.

CLASS II.—*Hearing lost between ages of one and five years.*

Mr. H., twenty-one years ; lost hearing from scarlet-fever at five years ; hears all vowels.

Mr. H., nineteen years ; lost hearing at eleven months ; hears and repeats all vowels, also three words.

Miss A. W., fourteen years ; lost hearing from scarlet-fever at three months ; gets A, O, and I.

N. L., aged twenty-three ; lost from brain-fever at two years ; no improvement ; no conduction, either ærial or osseous.

Mr. R., age nineteen ; spinal meningitis at five years ; hears and repeats four vowels out of five, also " Boston " and " Mississippi " ; cannot distinguish between " Baltimore " and " Boston."

CLASS III.—*Semi-mutes.*

Mr. D., forty years ; deaf on one side to such an extent that no sound could be distinguished on the other ; could converse with trumpet ; this condition had existed for over thirty-five years.

With otophone hears conversation easily with worse ear, and with the better one the instrument can be removed for at least four inches from contact with concha.

Case number two in this class is a curious one ; he has been educated as a deaf-mute and uses the sign language entirely, making his replies verbally, speaks naturally, and is an expert lip reader. With the otophone, however, he understands conversation perfectly with either ear.

Mr. H. has a natural voice ; lost his hearing from scarlet-fever at five years ; is now twenty-nine ; hears all the vowels and is doubtless capable of much improvement.

In view of the results obtained (as shown by the foregoing cases) in the appeal to sight, hearing, and memory, I shall conclude by calling attention to the following from a pamphlet by Samuel Sexton, M.D., New York, 1884, "On the Necessity of Providing for the Better Education of Children with Defective Hearing in the Public Schools," pp. 14, 15 :

" *The importance of early training for deaf children.*—Too much stress can scarcely be laid on the value of results obtainable in this way if early made, since the perceptive power may be much quickened by training in many instances, even where the middle-ear apparatus is defective. It would appear to be on the development of the perceptive tract, rather than on any change in the transmitting mechanism, that mental improvement depends in the very deaf who are taught aurally. The expert himself finds it no easy task to get at the facts in certain cases, especially in young children who have already been instructed as totally deaf, since they soon come to disregard the hearing sense entirely, and it remains to be determined in such cases how much the auditory nerve has deteriorated from disuse. The professed indifference to hearing should never prevent some attempts being made at instruction through the hearing organs, since a surprising amount of hearing may thus be found to exist. How many children one meets with who are backward in learning to talk, but finally, on getting to be three or four years old, gain their speech ! Such chil-

dren would get on much faster in many instances, it is believed, if regarded as partially deaf. While treating such children professionally I have seen beneficial results from the use of conversation-tubes, or the employment of voice at close range. This practice cannot be too early commenced. I have observed good results in children as young as eighteen months. In observing these cases one cannot but be impressed with the importance of normal hearing in the ready acquirement of speech, and that however imperfect the hearing may be, it has its uses in acquiring languages."

This is a very clear presentation by Dr. Sexton of the needs of the deaf and deaf-dumb, in whose behalf he has spent so much time and thought.

Also the following from Dr. C. H. Burnett before the Philadelphia County Medical Society April 27, 1887. (See *Medical News*, May 7th.)

#### EAR-TRUMPETS.

"There are three reasons, he said, why the deaf should use ear-trumpets :

"1. In order to aid the hearing. 2. To improve the hearing. 3. For the convenience and comfort of those conversing with the very deaf.

"1. The cause of ordinary deafness is, in most cases, a catarrhal thickening of the mucous membrane over the ossicles and the inner surface of the membrana tympani, leading to more or less ankylosis in these parts. Passive motion overcomes in them, to a greater or less extent, the immobility induced by this sclerotic process, as it does elsewhere in the osseous and muscular system. The form of passive motion which acts most naturally on the ossicula auditus and their joints, is sound. If, therefore, sound-waves are concentrated in more than usual quantity or vigor upon the stiffened membrana and the ossicles, as by means of an ear-trumpet, hearing is induced, if the auditory nerve is unimpaired. If the latter is impaired, no form of ear-trumpet will be of use.

"2. Not only does such a form of passive motion give immediate relief to the deafness in most cases, but such a



form of passive motion, acting frequently and systematically upon the ear, prevents further ankylosis in the conductors, and fatty degeneration of the auditory nerve from desuetude. This, of course, tends to a permanent improvement of the hearing, and, in some instances, patients come to hear at last without a trumpet. If such a force were brought to bear early in cases of deafness from ankylosis in the ossicula, the defects in hearing could, in most cases, be arrested, and, to some extent, removed. This form of aid to hearing has its happiest results in very deaf children, in whom the loss of hearing often entails loss of speech, if they have already learned it. If they have not learned to talk, and their deafness depends on catarrhal disease in the middle ear, and not on a lesion of the acoustic nerve, the use of a good ear-trumpet will rescue them from entire deaf-dumbness.

“ 3. The most useful ear-trumpets yet presented to his notice are those of Mr. Maloney, who exhibits them here to-night. They are not only useful as conductors of sound, succeeding where other forms fail, but they do not fit into the meatus. They are held to the ear, the aural end of the instrument being supplied with a disc, and not a tip for the meatus. This does away with bruising the canal, or exciting furuncles in it, so common in the employment of the forms heretofore in use. They have been devised in a scientific manner, and introduced to the profession on their own merit. The best results, or the most signal ones, have been obtained by the so-called silent instrument. This is simply because it is the most powerful, and hence renders most aid to the very deaf, the only people who are really willing to use any instrument. The smaller instruments are just as good for those not very deaf, and, if used by such patients, would aid in the retention of hearing, and tend to cure their hardness of hearing, as he has shown. But the less-afflicted class seem unwilling to use any form of ear-trumpet. All ear-trumpets of any value must possess some size in order to contain a column of air sufficient to impress the drum. They must be larger than the auricle with which the patient is already supplied. Hence, all invisible appliances, so-called, are self-evidently good for nothing.”

ON THE DIAGNOSTIC VALUE OF RINNE'S EXPERIMENT, WITH REMARKS ON THE PHYSIOLOGICAL FUNCTION OF THE SOUND-CONDUCTING APPARATUS.

By F. BEZOLD, of MUNICH.

Translated by J. A. SPALDING, Portland, Maine.

THERE is one peculiarity about the examination of the functions of the ear, and that despite the undeniable inefficiency of our present audiometers, in which we have an advantage over the other organs of special sense, and this is that we can produce the same irritation in two different ways, by aërial and by bone-conduction.<sup>1</sup> And further the patient can assist us by comparing directly with one another and measuring the variation in intensity of any given tones of the same force acting successively upon the ear by A. C. and B. C.

Ever since E. H. Weber discovered that a T. F. placed upon the vertex of the skull could be heard better in the obturated ear, innumerable aurists have endeavored to draw diagnostic conclusions from this observation which was soon discovered to be invariably present in cases of simple stoppage of the meatus, as well as in the greatest variety of disturbances in the sound-conducting apparatus.<sup>2</sup>

Weber's experiment is of no assistance in comparing B.

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<sup>1</sup> For the sake of abbreviation, the initials A. C. and B. C. will be largely employed throughout this translation for aërial, or bone-conduction, and further, T. F. shall signify tuning-fork, whilst when the plural of that compound word is intended, T. FS. will be employed.

<sup>2</sup> Schwartze's text-book, vol. i., p. 54, contains historical references (extending back to the year 1509), on the use of bone-conduction for diagnostic purposes.

C. with A. C., it simply shows the difference between the B. C. of the more affected ear and that of the less affected or healthy ear.

There are three methods of comparing the aërial and bone-conduction in any individual.

1. The simplest method of comparing the aërial or as we may call it the aëro-tympanal conduction, with the osteo-, or really cranio-tympanal conduction as Hensen styles it owing to the path which it follows, is to take a T. F. as free as possible from over-tones, to strike it against some hard substance, and then hold it in front of the ear till it ceases to sound, and then after striking it again, to let it cease to sound on any spot upon the skull. This method presupposes that the same part of the T. F. is struck twice in succession with the same force, a thing that can apparently be accomplished by means of an apparatus attached to the fork as described by Eitelberg.<sup>1</sup> But in this method there is great opportunity for errors in bone-conduction, owing to the fact that we cannot accurately measure the precise pressure with which the T. F. is held against the skull.

2. This error can be partially avoided by supplementing the A. C. and B. C. of the diseased ear with those of the normal, *e. g.*, our own ear, in that we measure how much longer the T. F. is heard by our ear, or shorter by the diseased ear, and then compare the results.

3. Rinne's experiment depends exclusively upon the amount of time by which the T. F. is heard longer by the tested ear by A. C., or under pathological conditions longer by B. C. than by the opposite form of conduction.

Although Rinne placed this experiment at the head of his papers on the physiology of the human ear, as far back as 1855, emphasized its constant occurrence in the healthy ear, and also correctly recognized its importance for our differential diagnosis, it nevertheless remained practically unutilized until in the last decade Lucae consistently employed this method of investigation in the chronic forms of deafness, noticed its occasional negative condition, and thus

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<sup>1</sup> These ARCHIVES, vol. xv., 299.

drew toward it once more the universal attention of aural surgeons.

The diagnostic value of these three methods has since been investigated by innumerable otologists with the assistance of other tests and experiments, and now one, and now the other has been pushed into the foreground as by far the most useful of them all, but we are still far from uniting upon one which shall best answer our theoretical demands and practical needs.

I have in the last six years, but without neglecting other methods, relied entirely upon Rinne's experiment as the crucial test in every case in which slightly pronounced alterations or none at all existed in the M. T., or whenever auscultation failed to solve the question of a diagnosis between an affection of the sound-conducting and sound-perceiving apparatus, and in the last three years I have noted its duration in seconds.

In a paper, "On the explanation of the relation between ærial and bone-conduction in Rinne's experiment,"<sup>1</sup> which I read before the Otological Society of Munich in 1885, I attempted to explain theoretically why B. C. so often exceeds A. C. in affections of the sound-conducting apparatus. The chief reason for that lay, in my opinion, in an increased tension of the sound-conducting apparatus, such as we have a right to assume in a great majority of diseases of the middle ear.

It seems to me a much more difficult task to demonstrate from a large mass of material the *statistical* value of the significance and practical applicability of Rinne's experiment, and all the more so, since long series of the same nature have lately been published, a large majority of which corresponded but slightly to our suppositions, whilst many were doubtful, and some entirely negative.

If we theoretically consider the relative reliability of the three methods just described, we shall see that Weber's experiment demands that the patient shall simultaneously direct his attention to impressions of hearing on *both* sides,

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<sup>1</sup> Published at Finsterlin's in Munich in 1885.

and then decide which of the two preponderates, or if the difference between the impressions is more pronounced, he has to decide in which ear the tone exclusively resonates. V. Troeltsch, in his work on the ear, long since emphasized the difficulty of this experiment even in the case of intelligent patients. This is especially true in the chronic cases in which bone-conduction is nearly all that we have to rely upon for our diagnostic purposes, whilst in the acute and sub-acute catarrhal diseases of the middle ear, and in suppurative cases, as well as in those processes chiefly confined to the Eustachian tube, the patients' answers upon this point are more precise. How often, too, the chronic affections are nearly *evenly* divided on the two sides, is seen in the following tables. In cases of the latter sort, therefore, it is plain, from the start, that we cannot safely rely upon Weber's experiment for any decisive diagnosis.

The patient is not required in the other methods to differentiate between the relative strength of simultaneous impressions of sound in both ears, but to determine one after another the audible limits of B. C. and A. C., or in other words he has simply twice to determine the "*threshold irritation*," *i. e.*, the minimum intensity which, in any given case, produces a perception. Inasmuch, therefore, as the threshold irritation is relied upon as a suitable and trustworthy aid in long series of psycho-physical and physiological investigations, and particularly so in the case of the organ of hearing in its normal state, we are justified in employing the same means in our diagnostic tests in the diseased ear. According to Vierordt,<sup>1</sup> "of course the perceptive force of any two persons cannot be precisely compared, but we can compare their threshold sensations, in regard to which we have the undeniable right to assume that they are substantially alike"—for which reason, "these measurements are free from any thing subjective."

Hessler has shown, by a long series of tuning-fork investigations upon his own person,<sup>2</sup> that there are but relatively few errors in determining the threshold value of the ear.

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<sup>1</sup> *Die Schall und Tonstaerke*, Tübingen, 1885.

<sup>2</sup> *Arch. f. Ohrenheilkunde*, xviii., p. 227.

Despite the fact that his T. F. S. were strong in tone, and slow in ceasing to sound, the variations in value so obtained were so slight as to be of no account at all in comparison with the audible duration of vibration of the forks as a whole, at least so far as all practical measurements were concerned.

Practical considerations alone ought to determine which of the three methods we are to prefer and to call the regular one in every case in which we test the relation between B. C. and A. C.

In the first method we have to determine, by a long series of normal ears, the precise length of time during which the T. F. employed can be heard, both by A. C. and B. C., since we do not yet possess any normal standard tuning-fork. In the second and third methods, however, there is no necessity for this preliminary determination of the normal audibility of the T. F. And we are entirely independent of the force with which the fork is struck. If, by the second method, we only measure the time which intervenes between threshold perception of the diseased ear and of our own healthy ear for A. C. and B. C.; and in the third, Rinne's experiment, measure exclusively on the diseased ear the time which lies between the threshold perception of sound when heard by B. C., and the same perception by A. C., or inversely, it is a matter of indifference how forcibly the T. F. is originally sounded, and the values in seconds as discovered and tabulated in a large number of patients are easy to compare with one another, if they have only been taken with one and the same T. F. In order to avoid all weariness of the ear, we should invariably begin with the weakest possible tone.

Since the great number of persons whom it is essential for us to examine by these methods for the sake of obtaining accuracy of diagnosis, demands an inordinate degree of attention, and largely infringes upon our practice, we must take into consideration the length of time which is needed for the different methods, and give the preference to that which gives the most useful results in the quickest possible time. And further still, in order to economize our

time in each experiment, we must remember that a large number of investigators are now agreed that it is well in every case to go through with these tests with at least two T. F. S. that vary extensively in pitch.

Rinne's experiment is quickest to perform, and the least wearisome. It does not tell us directly how much the hearing by A. C. or B. C. is diminished in comparison with the healthy ear, but it gives us instead that proportion which, as experience teaches us, is subject to the greatest variations in the disease with which we are here concerned, and therefore offers the most striking figures, whilst Rinne's assertion that the experiment always results positively in the healthy ear, has been unanimously confirmed by all authors.

Rinne's experiment should always be amplified by testing the B. C. by the second method. Emerson<sup>1</sup> showed how often the B. C. of a diseased ear surpasses that of a normal ear, and Schwabach, in his extensive statistical paper<sup>2</sup> on the value of Rinne's experiment, directed particular attention to the period of time for which a T. F. placed upon the vertex of a deaf person is heard longer or shorter than by a person whose hearing is normal, and has discovered from the positive or negative result of this experiment an important and further support for differential diagnosis between diseases of the middle and inner ear.

It would also be desirable to know how much the duration of A. C. is reduced in comparison with that of the healthy ear (measured according to the second method) in each individual case and for forks of varying pitch. This measurement, however, especially for a T. F. with a deep tone and one that slowly ceases to sound, is subject to the most extraordinary variations when repeated in the same persons, as some time since discovered by Schwabach, who also noticed at the same time that the duration of the perception by B. C. was much more constant. On the contrary the A. C. for *high* tones can be more advantageously studied with Lucae's *c*<sup>iv</sup> and *f* sharp<sup>iv</sup> forks in the method sug-

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<sup>1</sup> These ARCHIVES, vol. xii., p. 63.

<sup>2</sup> These ARCHIVES, vol. xv., p. 195.

gested by that author. Besides all this it is my opinion that we cannot dispense with the additional use of Galton's whistle, as suggested by Burckhardt-Merian, particularly in testing the highest tones of the scale, for in comparison with the tuning staff, it has the great advantage of containing, in immediate sequence, the three upper octaves of our perception of sound. It would be desirable, from a theoretical point of view, to test for A. C. and B. C. the entire scale, or at least a long series of tones evenly distributed over the entire scale, perhaps the entire octaves, as Hartmann has done in an extensive series of cases for the middle portion of the scale, which is after all the one with which human hearing is chiefly concerned. The complete gratification of this postulate is, however, impossible, as is also the construction of an audiometer corresponding to these ideal demands, and for the reasons that on the one hand we cannot find very deep T. F. S. that are free from over-tones, and on the other, that when the T. F. is higher than  $a^{11}$ , B. C. can no longer be carefully tested by itself, because the loud forks absolutely needed for perception in these cases, are audible to so great a distance that A. C. cannot be scientifically excluded from the investigation.

We are therefore obliged, especially for a regular examination that can be employed in every case, to content ourselves with testing a limited series of tones, and must give those the preference whose perception, as experience teaches us, most frequently suffers alteration—that is to say, the high and low tones.

Our chief aim ought, however, to be, so far as practical needs of hearing are concerned, to test invariably the most important *middle* portion of the scale.

I have for years for this purpose resorted to the common tuning-fork  $a^1$ , so generally found in the hands of musicians, and of which I own one that, if not struck too hard, is entirely free from over-tones. Its limbs are 8.2 *cm* long, 9.2 *mm* wide, and slightly more than 3 *mm* thick. The thin handle terminates in a round button. If permitted to vibrate freely in the air, it can be heard for 80 seconds by a person of normal hearing, 11 seconds if placed upon the



vertex, and then 30 seconds more by aërial conduction if held in front of the meatus.

Although its tone lies somewhat higher in the scale than the *a* and *a'* forks generally used by the observers of Rinne's experiment, the tables appended show that with this middle tone of the musical scale such remarkable variations are obtainable by Rinne's experiment, that this T. F. alone is capable of giving us entirely satisfactory diagnostic results.

I have of late found that I could not dispense with a second and deep T. F. for controlling and amplifying the results obtained by the *a'* fork. But the over-tones are too disturbing in a large contra A fork with arms 35 *cm* long, and a tone in the third octave below, whilst its size renders it somewhat unmanageable. In its place, therefore, I have lately employed an almost equally large fork, A (two octaves below *a'*), which, as the tables show, is of so great service in testing B. C., to say nothing of its value in Rinne's experiment, that I earnestly recommend its use in the same form in which I have employed it. Its arms are 25 *cm* long, 19 *mm* wide, and  $7\frac{1}{2}$  *mm* thick. The over-tones of this fork, also, were originally very disturbing, but by means of a very simple contrivance I have succeeded in eliminating them so well that they are not perceptible even when the fork is struck moderately hard. This apparatus consists of an iron ring placed around the handle and soldered to the stem and base of the arms, and experiments have shown that when the ring satisfactorily covers the arch of the fork with the two nodal points, that the over-tones entirely disappear, even when the fork is struck quite hard, although at the same time it must be acknowledged that the intensity of the original, fundamental tone is considerably diminished. If now we file the ring away on both sides till the over-tones are just heard when the fork is struck with great force, we obtain at one and the same time greater intensity of the fundamental tone and an entire absence of over-tones when the fork is struck with considerable force only.

This T. F., if struck moderately hard, can be heard 90 seconds by A. C. in a normal ear, 24 seconds by B. C. from the

vertex, and then, after ceasing to sound, it can be heard for 42 additional seconds by A. C.

Unfortunately, we must not forget that the vibratory power, and particularly the presence of more or less intense over-tones in tuning-forks, are dependent not only upon the size and form of the fork, but that the material of which it is made takes a share in all these properties—the same thing as we learn in the construction of violins. It is this circumstance, too, which renders it impossible for us to construct forks that shall be precisely similar in tone, even when their dimensions are the same. A fork which greatly resembles those above mentioned, and which I used for out-patients, resonates about as long, but it is full of over-tones, a circumstance which is, in my opinion, due to excessive hardening of the steel. The results that I have obtained with this instrument vary wonderfully from those obtained with the previous fork, and particularly in that there are but very few cases in which it cannot be heard by A. C., and this, on the contrary, is something which frequently occurs when using the fork upon which I have relied since my investigations began.

This A tuning-fork weighs 860 grammes, the a' fork 60 grammes. The great weight of the former makes it disadvantageous for general use, but it has the advantage of showing great uniformity of results in a long series of cases. As we have already mentioned, the force with which the T. F. is pressed against the skull exerts considerable influence upon the duration of B. C.; the greater the pressure, *i. e.*, the more perfectly the handle remains in contact with the bone, the more unimpeded the escape of waves of sound through the bone, and the greater the rapidity with which the T. F. ceases to sound. This pressure, in the case of the larger forks, can be easily regulated by simply holding the handle perpendicular to the bony surface and letting its own weight hold the fork *in situ*. We can thus exclude a source of error which is so very common whenever we employ the a', or other small tuning-forks, experimentally.

It is very difficult to arrange statistically the utility of Rinne's and other methods of testing the hearing with

forks. We know well enough, for instance, how defective is our foundation for the differential diagnosis between chronic diseases of the sound-conducting and sound-perceiving apparatus in all those cases in which, in the living, there was, on the one hand, a lack of positive symptoms on the part of the *Mt*, as well as of the contents of the tympanum, and on the other hand, of nervous symptoms or of any other points that could possibly be utilized in this direction. V. Troeltsch has frequently enough emphasized the necessity of caution in judging even enormous alterations in the *Mt*, so far as concerns our diagnosis of the disease that really causes the loss of hearing, and I myself have lately experienced this fact in making my examinations amongst young children in the common schools.<sup>1</sup>

If, therefore, we desire to obtain any binding conclusions from the results of Rinne's or any other T.-F. tests, we must not assume as our standard of comparison the generally accepted diagnostic points, as has been done in nearly all the statistical papers so far published on Rinne's experiment. If our standard is incorrect the answers from our patients and material will of course be untrustworthy and indecisive.

We may, however, proceed inversely, and in classifying our cases start *from the results of Rinne's experiment*, which at least in a large number of deaf persons shows such colossal variations, that errors on the part of the less intelligent persons can for these cases at least be excluded with moderate certainty. The uniform, positive result of Rinne's experiment in the natural ear justifies us in assuming that the remarkable variations from the normal observed in deaf persons are also due to the same purely physical causes within the ear as account for its uniform result in the normal ear.

In this respect we distinguish two well-defined groups, the one in which, despite a high degree of deafness in both ears, Rinne's experiment results about the same as in the normal ear, the other in which on both sides B. C. not only

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<sup>1</sup> These ARCHIVES, vol. xiv., pp. 158, 242.

lasts as long as A. C., but even longer to a greater or less degree. Owing to the influence exerted upon B. C. by the sound ear, we shall do well in our comparisons to exclude entirely those who are deaf on one side only, as well as those in whom Rinne's experiment results positively on one side, and negatively on the other, because they cannot help us to arrive at any correct decision.

If now we find that the other tuning-fork investigations in each of the different groups show a certain general agreement, and that, further, a larger number of peculiar symptoms recur in each with a certain regularity, we obtain, as I think, new and reliable proofs of the utility of Rinne's experiment.

This is the path that I have followed in collating the following tables, in which the result of Rinne's experiment whilst using the  $a^1$  T. F. has served as a standard for classification.

In order to form some idea of the frequency with which this experiment gives us decisive results, I have included in the tables all of my private deaf patients during the first six months of 1886. Here we find all those cases in which with an intact *Mt* visual inspection and the use of the douche failed to show any reasonable cause for the deafness. I have excluded all cases of acute and subacute middle-ear catarrh, with well-pronounced tubal affection, and accumulation of secretion, as well as all cases recognizable as the sequel of otitis media purulenta; further, all extensive cicatrices and calcifications in the *Mt*,<sup>1</sup> and finally the cases of total unilateral deafness.

Some of the tables are unfortunately imperfect, so far as the details of the examination are concerned, partly because at first I did not pay sufficiently careful attention to all the various points, and partly because in some cases I postponed the rest of the examination to a subsequent visit, but was never able to complete it. Nevertheless I have no hesitation in publishing the series; for it will, at least, show how far Rinne's experiment can be universally utilized during

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<sup>1</sup>A portion of the latter are, for sake of comparison, contained in a following table.

a busy practice. If only once any given method has obtained citizenship in science, it is to be hoped that thereafter it will be more regularly carried out.

Rinne's experiment can be performed in the following method: The a<sup>1</sup> T. F., after being struck a moderate blow on one of the angles of its arms against a bit of soft wood is placed firmly upon the mastoid process just beneath the crista temporalis, but without touching the muscle, and the time in which it ceases to sound noted with a watch provided with a seconds-hand. The time is next to be measured as directed in Schwabach's<sup>1</sup> and Rohrer's paper,<sup>2</sup> in which the fork with the end of its arms directly in front of the concha reverberates still further by A. C., and this time in seconds to be noted as an expression of the positive results of the experiment. When the fork was not heard at all by A. C. after it had ceased to sound by the bone, I was not satisfied like most other observers, but I experimented inversely, first holding the fork in front of the ear after a moderate stroke, and then when it ceased to sound by A. C. I placed it on the mastoid process, and measured in seconds the time for which at this spot it continued to sound.

The latter duration cannot absolutely be compared with that discovered when Rinne's experiment results positively, because the T. F. placed upon the skull (or any other firm body) ceases to sound in less than half the time than by the air even when struck with equal force. Hence the values discovered in this inverse method ought to be doubled if they are to be compared as of equal value with those obtained when Rinne's experiment results positively. I. If, *e. g.*, the fork a<sup>1</sup> after ceasing to sound by A. C. is heard 10 seconds longer on the mastoid, the A. C. in comparison with B. C. is not only abbreviated by the 30 seconds by which the normal ear hears longer by the air than by the bone, but further by the additional 10 seconds during which it renews its sound from this new spot; but as the T. F. dies away here about one half quicker, the real difference between

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<sup>1</sup> *L. c.*

<sup>2</sup> *Die Rinnesche Versuch, etc., Zuerich, 1885.*

this result and that obtained in the normal ear by Rinne's experiment amounts to at least  $30 + 2 \times 10 = 50$  seconds.

This reckoning has not been carried out in the tables, but the number of seconds simply noted by which A. C. surpassed B. C., or vice versa. In reality the differences are greater than are expressed by the values in seconds. I have nevertheless confined myself to these, as directly discovered, because on the one hand I had at command too small a series of measurements in the normal ear to be sure of the proportion which exists between the period of a T. F. vibrating freely in the air and one resting on firm bone, and on the other because the differences, even if we only consider the number of seconds, are large enough to enable us to exclude subjective errors and failures of observation, and thus to enable us to draw accurate diagnostic conclusions.

The experiment was also carried out in a similar manner with the large A fork, only B. C. was not measured from the mastoid process, but from the vertex, partly because it is harder to localize the tone of the large fork in *one* ear, and partly because when these experiments are carried out on the vertex, the pressure with which the A fork is applied is more easily regulated, for we simply let its own weight keep it in position.

Various abbreviations have been introduced into the tables and this paper, to show how Rinne's experiment results, and these demand some explanation. I should not like to replace the terms "positive" and "negative" with any abbreviations, and, as Politzer has suggested,<sup>1</sup> in order to avoid embarrassment I would rather choose for Weber's experiments other terms—*c. g.*, W. i. w. = Weber in worse, W. i. b. = Weber in better ear, because in this experiment there is no question of figures, as in Rinne's.

The number of seconds found in the latter represents the difference between the duration of A. C. and B. C. If we represent A. C. by *a* and B. C. by *b*, then  $a - b = x$ .

If A. C. lasts longer than B. C., as is always the case in

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<sup>1</sup> Rohrer: *Muenchener Med. Wochensch.*, No. 23, 1885.

the normal ear,  $x$  is a positive value, and, on the contrary, a negative value if B. C. lasts longer than A. C. If  $a$  and  $b$  measure precisely the same, *i. e.*, if the fork, after ceasing to sound on the bone, is no longer heard by A. C., or inversely, is no longer heard by the bone after it has ceased to sound by the air, then  $x = \pm 0$ .

If the fork is not heard at all by B. C., but only for a slight interval for A. C., then, in the above formula,  $b = 0$ , and  $x = +a$ .

If, on the contrary, there is no A. C. and B. C. measures no matter how many seconds, then  $a = 0$  and  $x = -b$ .

Finally, if there is neither A. C. nor B. C. for the fork, the difference between both is 0, and is so designated in the table.

If we leave aside the latter condition, which is quite exceptional, unless in cases of very slight capacity for hearing conversation, we can designate the various ways in which Rinne's experiment may result by  $+a + x \pm 0 - x - b$ , in which  $x$  denotes the number of seconds by which A. C. or B. C. predominates.

These terms are not intended to be mathematically exact; they simply represent easy abbreviations of practically attainable results, and as such they deserve to be generally acknowledged by the profession, like the long-accepted Snellen terms for acuteness of sight and the analogous abbreviations for the range of hearing suggested by Knapp and Prout; indeed, they are still more defective so far as accuracy is considered, because Hensen<sup>1</sup> has shown by experiments with three tuning-forks, that no fork ceases to sound with equality of diminution throughout, but that at a short time after being struck the sound ceases slowly, and then after a while it begins to die away with greater rapidity. Nevertheless, despite their imperfections, I should not like to be without the expression of our T.-F. investigations in figures, since they first interest us by their extremes, and secondly, only the strongly pronounced contrarieties which are thus shown are to be relied upon in drawing any conclu-

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<sup>1</sup> Hermann's *Physiologisches Hand-Buch*, Band iii., p. 120.

sions. Thus the table will often show at a glance how often the two extremes  $+a$  and  $-b$  are observed in testing with deep forks.

It will be difficult, I think, to find an audiometer which can be used with so great perfection as the deeper forks for the comparative testing of A. C. and B. C., and which shall cease to sound so evenly as these.

The following tables 1*a* and 1*b* contain all my private patients between January and July in whom there was total bilateral deafness without any essential alterations visible upon the *Mt*, nor to be discovered with the douche, and in whom Rinne's experiment with the *a'* fork resulted *negatively*.

Column 3 contains the hearing for whispered voice in *cm*, but when this could not be distinguished close to the ear, or not at all, then the column shows the hearing for conversational voice.

Inasmuch as my investigations among 1,282 school-children,<sup>1</sup> in a space with a diagonal of 20 *M*. showed me how large a portion (207) could hear farther than this distance, whilst 146 could hear at least 19 *M*., and since this number grew smaller and smaller with each successive metre, the normal hearing for my whispered voice in *cm* can be regarded with Knapp and Prout as  $\frac{2000}{20000}$ , and each figure in column 3 is to be completed by adding the denominator 2,000 in case of a whisper, and of 6,000 in case of a conversational tone, as this can be heard about three times as far as a whisper. The same school investigations also showed that my whisper could be heard about as far as Politzer's audiometer, and for that reason I did not make any control-tests with that instrument, because we are much more interested in the comprehension of speech, and hence the use of speech as an audiometer with the above-mentioned cautions gives perfectly satisfactory results.

Column 4 contains in section *a* the result of Rinne's experiment with the *a'* fork in seconds; column *b* (1) Weber's experiment, which, as it resulted better or worse, is so

<sup>1</sup> Schuluntersuchungen ueber das kindliche Gehoerorgan.



marked, or when the patient could not decide in which ear the tone was heard, it is marked "undecided," and (2) the time that the T. F. occupied in dying away on the vertex. The positive figures here indicate in seconds the time by which the patient heard it still longer on the vertex after I had ceased to hear it when placed in the same position on my head, and inversely the negative figures show the time by which I heard it longer by B. C. than did the patient.

Columns 5 *a* and *b* contain the results of Rinne's and Weber's experiments as tested by the large A fork, except that Rinne's experiment and the duration from the skull, were tested from the vertex instead of from the mastoid process.

Column 6 contains the limits in units and tenths of Galton's whistle perceived as a scream. The same instrument was employed in all the tests, one whose higher tone-limit measured by the normal ear amounted to 2.0 degrees on the register. It is difficult to express this precisely in tenths, because in the production of the tone it is impossible to know how forcibly the whistle is blown by pressure on the bag; with a strong puff a weak tone can be perceived so low as at 1.7. For this reason the bag should always be weakly pressed during these experiments.

I have further discovered by the aid of three of these whistles, that the upper limit of tone in one instrument does not always lie at the same place on the scale of other instruments, but differs by several tenths. It is therefore essential to fix in every instrument by means of normal ears the spot that corresponds to the upper limit of tone.

Inquiry was made in every case in regard to the presence of tinnitus, vertigo, heredity, and paracusis Willisii. The remaining columns need no further preliminary remarks.

Remarks.—The age of the 49 patients varied as follows: 3 between 10 and 19; 13 between 20 and 29; 19 between 30 and 39; 9 between 40 and 49; and 5 between 50 and 57.

Deafness had existed in 7 cases since youth, but in the majority of cases for several years. This type of disease consequently seems to be infrequent in infants, rather common in young persons, and generally beginning between 20 and 40 years of age.

TABLE 1a.—NEGATIVE RESULT C  
BILATERAL AFFECTIO

No.	Age.	Side.	Hearing for whisper and conversation in cm.	Tuning-fork a <sup>1</sup> .		Tuning-fork A.		Galton's whistle.	Condition of membrana tympani.	Subjective noises.
				a	b	a	b			
				Rinne, from mastoid.	Weber, and duration from vertex.	Rinne, from vertex.	Weber, and duration from vertex.			
1	14	R.	w 12	— 5	Undecided.	— 22		2.1	Both normal.	
		L.	w 12	— 6		— 20	+ 12	2.2		
2	33	R.	w 18	— 5	In worse.				Both normal.	Occasion
		L.	w 4	— 7	— 3					knocking
3	30	R.	w 2	— 7	Undecided.				White limbus.	Occasion
		L.	conv. 8	— 5	+ 3					roaring.
4	38	R.	w 8	— 5	Undecided.				Both normal.	Constan
		L.	w 7	— 6	— 3					roaring.
5	17	R.	w 6	— 8	In worse.	— b	In worse.	2.3	Opacities in centre.	Occasion
		L.	w 8	— 8	+ 0	— 21	+ 12	2.3		roaring.
6	32	R.	w 18	— 8	In worse.	— 24	In worse.	1.9	Opacity in post.	Constan
		L.	w 6	— 8	+ 0	— b	+ 21	2.3	periphery. Opacities along ham-	roaring.
									mer.	
7	57	R.	w 7	— 8	Undecided.				Normal.	Constan
		L.	w 6	— 9	+ 3				Normal.	roaring.

The rest of this table, cases 8 to 34, is omitted in the translation.

TABLE 1b.—NEGATIVE RESULT  
BILATERAL AFFE

No.	Age.	Side.	Hearing for whisper and conversation in cm.	Tuning-fork a <sup>1</sup> .		Tuning-fork A.		Galton's whistle.	Condition of membrana tympani.	Subjective noises.
				a	b	a	b			
				Rinne, from mastoid.	Weber, and duration from vertex.	Rinne, from vertex.	Weber, and duration from vertex.			
1	47	R.	w 3	— 5	Undecided.			2.5	Radiating opacities.	Occasion
		L.	w 3	— 4	+ 4			2.5		roaring
2	32	R.	w 5	— 5	In better.				Diffuse opacities.	Constan
		L.	conv. 5	— 5	+ 0					roaring
3	30	R.	w 5	— 5	Undecided.				Slight opacities.	Constan
		L.	w 12	— 6	+ 0					roaring
4	31	R.	w 10	— 5	In better.			3.0	Normal.	Occasion
		L.	w 4	— 6	— 3	b		3.5		ly like bel
5	56	R.	conv. 15	— 6	In better.	b		4.5	Exostoses in meatus.	Occasion
		L.	conv. 3	— 6	— 5	b		4.0		roaring
6	25	R.	w 8	— 7	In worse.				Opacities.	
		L.	w 40	— 6	+ 0					
7	40	R.	w 12	— 6	Undecided.				Normal.	
		L.	w 25	— 5	+ 0					

The rest of this table, cases 8 to 15, is omitted. —TRANS.

RINNE'S EXPERIMENT.

WOMEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paracusis Willisiana.	Causation.	Duration.	Treatment and remarks.
Frequent attacks of vertigo.	Sister.		After salicylication. Since erysipelas. Worse after catarrh. After endometritis.	Several years. Eight years. One year. Three years.	Catheterism good and improves R to 20 and L to 30. Catheter increases R to 30. Catheter increases R to 4, L conv. to 15. Catheter improves R to 12, L to 9.
Attacks of vertigo.	Mother and two of father's sisters. Father.	Hears much better in a noise. Hears much better in the cars.		Three years.  Since childhood.  Eighteen years.	Catheter improves R to 8, L to 15.  Catheter improved three years ago R, but not now; then, Rinne was + 10. Hears thunder poorly. Catheterization perfect.

RINNE'S EXPERIMENT.

ON IN MEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paracusis Willisiana.	Causation.	Duration.	Treatment and general remarks.
	Father.	Can hear on locomotive.	Rheumatism. Nervous symptoms.	Two years. Four years. Six months.	Catheter, but no improvement. Catheter. No improvement R. L, conversation at 8. Catheter improved L only to 18.
	Father.			Several years.	No improvement by catheter, refractor, or pressure-probe.
	Sister.			Many years.	Catheter. No change L. R improved to 18.
	Father and two brothers.			Eighteen months.	Catheter. R, 15. L to 50.
	Brother very deaf and defective in speech.			Since youth.	Catheter and Lucae's pressure-probe of no avail.

The hearing amongst 98 ears was less than 20 *cm* for whisper in 74, and in 24 of the remaining only 4 times did it amount to 100 *cm* or over.

The result of Rinne's experiment in the 98 ears, with the fork *a'*, was 1, — *b* (with conversation at 3 *cm*).

12, — 10 to — 12.

82, — 3 and — 9.

3, + 0.

The result of Weber's experiment with the same fork was, in 49 persons, as follows :

12 times, undecided, owing to equal or nearly equal hearing of both ears ;

15 times in the worse ear ;

8 times in the better ear ;

5 times no notes were taken.

The duration of the perception of the *a'* fork from the vertex :

19 times coincided with mine ;

9 times surpassed it from 3 to 5 seconds ;

16 times was less than mine by from 2 to 6 seconds ;

4 times it was not measured.

Rinne's experiment with the *A* fork resulted, in 58 ears, as follows :

32 times — *b*, *i. e.*, the fork was not heard by *A. C.*, but from the vertex ;

18 times between — 12, and — 25 ;

8 times — *x*, *i. e.*, the duration was not precisely noted.

Weber's experiment with the same *A* fork resulted, in the few cases examined, almost invariably, in favor of the worse ear.

The duration of the perception of the *A* fork from the vertex was compared with my own in 22 individuals; 21 of them heard from 8 to 21 seconds longer than myself, whilst only one person, whose answers in other points were rather unreliable, heard it for a shorter time, and then by 12 seconds.

The upper perception of high tones, by Galton's whistle, resulted, in 64 ears, as follows :

27 times normal, and over-normal between 20 and 1.6 ;

37 times below normal between 2.1 and 4.5.

The membrana tympani in 98 cases was:

50 times normal ;

27 times circumscribed opacities in various regions ;

11 times diffuse opacities ;

4 times slight diffuse rosy opacities ;

2 times radiating stripes on the light spot ;

1 time reflex behind short process ;

1 time calcification of the anterior limiting tendon ;

2 times exostoses in front of the short process, and furthermore, two dark spots on *Mt*.

Subjective noises were absent but 11 times in 49 individuals, 23 times they were constant, and 15 times occasional.

There was but one case in which the constant noise could be stopped by pressure upon the carotid. The noise most frequently resembled a roaring, yet some of the patients complained of hearing tones, the chirping of crickets, the ringing of bells, etc.

14 of the 49 complained of occasional attacks of vertigo, but generally without any especial characteristics ; sometimes they were only noticed after blowing the nose, or closing the eyes, and no one ever completely resembled the Ménière's complex of symptoms.

Heredity was observed in 29 cases out of 49 patients ; *i. e.*, in 59 %. And here we reckon only the progenitors and brothers or sisters. Of this number, 17 showed a single branch affected with deafness, and 4 three branches.

Paracusis Willisiana was observed 16 times ; sometimes the patients informing us of this condition voluntarily, sometimes only when asked. This was noticed mostly, or most clearly, whilst on the cars.

Amongst the causes we cannot help noticing in women the coincidence of the deafness, or, at least, of a great decrease of hearing, with delivery, and this is shown by 5 cases out of 34. Nasal and naso-pharyngeal catarrh were not more frequent than in those with normal hearing. All of those cases were excluded in which there were within the ear any symptoms that might suggest an extension through the tube.

The process generally extends over years, and the hearing generally grew gradually worse, except in the childbed cases just mentioned, in which the decrease was rapid.

Air could generally be passed by the catheter into the middle ear without much, if any, difficulty, and the auscultation sound was generally normal. On one occasion upon using Delstanche's refracteur, it seemed as if the handle of the hammer moved imperfectly or not at all, but in all the other cases the hammer was perfectly mobile after rarefying the air in the meatus.

Thirty per cent. of the patients were men and 70 per cent. women.

Tables IIa and IIb show all of those *bilateral* affections with otherwise negative symptoms, in which Rinne's experiment was entirely or almost entirely positive with the a' fork, with little or no shortening.

Remarks—The patients were distributed according to age in this manner :

1 between 10 and 19; 1 between 20 and 29; 4 between 30 and 39; 7 between 40 and 49; 4 between 50 and 59; 5 between 60 and 69; 3 between 70 and 79; and 1 over 80.

The affection began 4 times in childhood.

The number of older patients here is remarkably greater than in the preceding tables, with negative result of Rinne's experiment.

The hearing in these 52 ears was 33 times less than 20 *cm*, and in the remaining 19 only 8 times greater than 100 *cm* for whisper. Most of the patients, therefore, show about the same hearing as those in table 1, and for this reason the totally different result of the tuning-fork tests is remarkable.

Rinne's experiment with the a' T. F. was :

10 times + a, *i. e.*, the T. F. was heard only by A. C., not at all from the mastoid process or vertex ;

18 times between + 30 and + 21 ;

20 times between + 20 and + 11 ;

3 times between + 10 and 0 ;

1 time + 0 (+ 27 on the opposite side).

Weber's experiment with the a' T. F. gave the following results :

6 times it was not heard from the vertex ;

5 times it was undecided, because the hearing was alike, or nearly so, in each ear ;

10 times the fork was heard in the better ear, and twice no notes of the result were preserved.

The a<sup>1</sup> fork was heard for the following period from the vertex :

6 times not at all ;

16 times shortened by from 2 to 6 seconds ;

3 times + 0, *i. e.*, like my own, and it was not lengthened a single time.

Rinne's experiment with the A T. F. was tested in 32 cases:

2 times it was neither heard by B. C. nor A. C., whilst the a<sup>1</sup> fork was heard by A. C.

18 times the result was + a, *i. e.*, it was heard by A. C., but not from the vertex ;

29 times it varied between + 53 and + 10 seconds ;

2 times the duration was not measured, and

1 time it was — 10.

Weber's experiments with the large fork A were mostly noticed in the better ear. This fork also was never lengthened from the vertex, but whenever its duration was measured, it was either shortened or not heard at all.

Galton's whistle was tested in 36 ears, and resulted :

19 times normal, 2.0 to 1.7 ;

17 times less than normal, amongst these 5 times between 5.0, and 10.5.

Case No. 7 showed tone-defects for the c<sup>ii</sup> and f<sup>iv</sup> sharp forks, whilst the c<sup>iv</sup> sharp lying between was heard. Galton's whistle was heard at the normal limit by this patient about 2.0, and no other defects in the scale could be discovered.

I would here remark that the patients of this group repeatedly complained of sensitiveness to tones and noises, piano-playing, Galton's whistle, etc. Two of the patients (musicians) complained also of *false hearing* ; the former (an instrument maker) accidentally mentioned that with his right ear with conversational capacity of only 3 cm, and in whom Galton's whistle was only heard at 10.5, the tuning-forks A and a<sup>1</sup> were perceived two octaves too high.

TABLE IIa.—POSITIVE RESULT OF RINNE'S EX.  
BILATERAL AFFEC

No.	Age.	Side.	3 Hearing for whisper and conversation in cm.	4 Tuning-fork a <sup>1</sup> .		5 Tuning-fork A.		6 Galton's whistle.	7 Condition of membrana tympani.	8 Tinni us.
				a Rinne from mastoid.	b Weber, and duration from vertex.	a Rinne, from vertex.	b Weber, and duration from vertex.			
1 77	R. L.	w 4 w 4	4 4	+ 15 + 13	Undecided. — 5			2.7 2.0	Slight folds. Opacities.	Roaring like a river for 2 years.
2 82	R. L.	w 3 conv. 60	3 60	+ 12 + 12	In better. — 5			2.0 9.0	Posterior opacifica- tion.	Constant roaring.
3 54	R. L.	w 10 w 50	10 50	+ 16 + 17	Undecided. — 6	+ 20 + 22	In better. — 8	3.2 1.7	Narrow white limbus in both.	
4 38	R. L.	w 5 w 4	5 4	+ a + a	From vertex. o	+ a + a	From vertex. o	3.0 3.5	Diffuse opacity.	Noises from the start "like a crowd of people." Constant singing.
5 57	R. L.	w 20 w 15	20 15	+ 18 + 14	— 6				Normal. Normal.	
6 33	R. L.	w 4 conv. 3	4 3	+ a + a	o From vertex.	+ a o	From vertex. o	2.0 2.0		Constant roaring from the start.

NOTE.—Cases 6 to 23 omitted.—TRANS.

TABLE IIb.—POSITIVE RESULT OF  
BILATERAL AFFECTION

No.	Age.	Side.	3 Hearing for whisper and conversation in cm.	4 Tuning-fork a <sup>1</sup> .		5 Tuning-fork A.		6 Galton's whistle.	7 Condition of membrana tympani.	8 Tinnitus.
				a Rinne from mastoid.	b Weber, and duration from vertex.	a Rinne from vertex.	b Weber, and duration from vertex.			
1 49	R. L.	w 60 w 300	60 300	+ 28 + 27	Undecided. + o				Opacity in anterior superior quadrant.	Constant roaring. Right.
2 61	R. L.	w 100 w 20	100 20	+ 26 + 16	in better — 4	+ a + a	from vertex. o	2.0 2.0	Normal. Normal.	Intermit- tent roaring in both ears.
3 76	R. L.	w 3 w 3	3 3	+ a + 25	o from vertex.	+ 19 + 21	— 10	2.2 2.3	Circumscribed opacities in periphery.	Constant noises, e. g., trumpets, bells, etc.



PERIMENT, WITH LITTLE OR NO SHORTENING.

TION IN MEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paraculis Willisiana.	Causation.	Duration.	Treatment and remarks
Occasional short attack of dizziness forward.			Working near a large steam hammer.	Several years.	No improvement after catheter.
				2 years.	No improvement by catheter; gradually grew worse.
				3 years.	Catheterization faint, no change L for 2 years; decrease R sensitive to loud noises.
For first six months constant vertigo with occasional emesis.			Syphilis twenty years before; inunction cure.	2 years	Catheter improves R to 10, L to 5. The a <sup>11</sup> fork heard only by A. C. not by B. C. at all.
Frequent vertigo.				15 months.	No improvement by catheter nor by potassic iodide; decreased one half in one year.
Vertigo for two years; within the last fortnight worse.				2 years.	Catheter of no use. Pilocarpine treatment.

RINNE'S EXPERIMENT, WITH LITTLE OR NO SHORTENING.

IN WOMEN.

9	10	11	12	13	14
Disturbances of equilibrium.	Heredity.	Paraculis Willisiana.	Causation.	Duration.	Treatment and remarks.
Vertigo on bending over.	Mother and mother's father deaf.			Four months.	
Frequent characteristic attacks of vertigo with repeated vomiting.				Two years.	Worse before vertigo; once reduced both ears to 25. After pilocarpine, 2 1/2 months, R 150, L 35.
				For many years.	Sensitiveness to tones and occasional false hearing. Catheter 10 to 8. Five weeks later R 4, L 6.

The membrana tympani in 52 cases was :

26 times normal ;

15 times with circumscribed opacities, 7 of which were posterior, and once there was a trace of folds ;

10 times with diffuse opacities, amongst these one trace of folds and vascular injection ;

1 time, exostosis in front of the short process.

Subjective noises were absent 7 times, 15 times constant, and 4 times occasional. They were more varied than in the previous tables, their initial stage more accurately fixed, and many times they could be attributed to a definite cause, like a detonation, for instance, to which the ear had been exposed. The tinnitus is often noticed as an associated symptom, with a violent attack of vertigo, and for that reason clings vividly to the patient's memory.

Disturbances of equilibrium were present 14 times in 26 patients, and of these 5 cases were severe, characteristic, repeated, and greatly resembling Ménière's complex ; the remaining 9 cases were less severe, rarely noticed except on leaving the bed in the morning, or on bending over, looking up to the sky, etc. The tinnitus and hearing did not always grow worse at the incipency of an attack of vertigo, but, on the contrary, it was repeatedly noticed that a successive decrease of hearing and increase in the subjective noises generally preceded an attack of vertigo by several days, whilst at the appearance of a severe and characteristic attack of vertigo, with vomiting, etc., the hearing improved, and the tinnitus decreased rapidly.

Heredity is but sparsely noted in this group. In 26 patients there were 4 cases of this influence : once single, once double, once threefold, and once sixfold (2 aunts, 2 brothers, and 2 sisters).

Paracusis was discovered but once.

Amongst the causes of the deafness, etc., we find syphilis noted three times. Six of the twenty-three men are zealous marksmen, have practised a great deal in closed rooms, and these complained of the extreme reverberation within this space. Three of the men referred the beginning of their attack of deafness to a detonation. Amongst the

other patients were two who work at the steam hammer in a large manufactory, where it is notorious that all grow deaf who have any work to do near this machine. One patient ascribed his deafness to extreme mental exertion, working many hours daily over finance, and late into the night over theoretical studies.

The course and treatment of this group show many interesting points. The patients often mention the sudden beginning with disturbances of equilibrium and subjective noises. Several cases exhibited great variations, not only in the subjective symptoms, vertigo and roaring, but in the hearing, which often rapidly decreased; and then again, frequently after characteristic Ménière's complex, it would as rapidly increase, and almost invariably to an astonishing degree. Such startling alterations in hearing as these were never observed in patients belonging to Tables I and Ia. I venture all the less to decide whether this rapid return of function in these cases is to be regarded as due to the use of potassic iodide, pilocarpine, etc., since, in a colleague whom I once examined before these tables were begun, I had a chance to learn by experience that such rapid changes can occur in this form of disease without any interference on our part. This man had been moderately deaf for years, and had repeatedly suffered from attacks of Ménière's symptoms. When I saw him again his hearing had rather suddenly decreased to so great an amount that he could only hear conversational speech close to the ear; nevertheless, Rinne's experiment resulted positively; there were no inflammatory symptoms, and Ménière's symptoms were entirely absent. A proposed pilocarpine treatment was, for good reasons, postponed. When I accidentally examined the patient, a week later, his hearing had increased in the right ear from 8 *cm* for whispered voice to 2 metres, and that without any treatment at all.

In regard to the pilocarpine treatment, as suggested by Politzer, I would say that, so far, I have had such favorable results that I am prompted to continue still further my investigations with this remedy, and especially in fresh cases.

The two sexes are more disproportionally divided in

these than in the previous tables, since here, in tables II and IIa, we find 89 per cent. men and only 11 per cent. women.

Although there are so few patients in tables II and IIa yet they deserve to be used statistically, because they show *all* the cases with these complex of symptoms that came under my notice within the space of six months. As I remarked above, I have excluded all acute and sub-acute forms, all forms with noticeable pathological alterations in the *Mt*, and those discoverable by the air douche (liquids), also all pronounced concavities of the *Mt*, and collections of secretion within the tympanum, all distinctly recognizable cicatrices of the *Mt*, and finally all cases of unilateral deafness.

Further omissions from the tables included all *bilateral* diseases in which Rinne's experiment was positive on both sides, but decidedly abbreviated in comparison with the amount of hearing, as well as those in which the same experiment resulted positive on one side and negative on the other, and all *unilateral* forms of deafness, no matter whether Rinne's experiment resulted positively or negatively. Affections of the first sort fail, with Rinne's test, to give accurate results for the differential diagnosis between diseases of the middle and inner ear; these are the cases which I collected under the title of "dysacusis" in my previous reports. With unilateral deafness we cannot exclude B. C. into the healthy ear from the mastoid, if we use the small fork, or even from the vertex if we use the large A fork. This is the reason, at least in high degrees of unilateral deafness, why, despite a perfect condition of the sound-conducting apparatus, A. C. is exceeded by B. C.; the latter appertains partly to the healthy ear. Rinne's experiment can, consequently, in these cases, result negatively, even in purely nervous affections. Both groups would simply have obscured the perfect picture which the bilateral affections alone are able to offer us when Rinne's experiment results either decidedly positive or decidedly negative; and for that reason they will be found further along by themselves.

The cases in the first two tables offer frequently recurring

peculiarities, not only in their relation to Rinne's experiment, but in their entire series of symptoms; a partially different set of symptoms is to be found with the same frequency in the second set of tables. The distinction between the morbid picture of the two groups can best be seen by arraying their principal symptoms in antagonistic columns.

TABLES 1*a* AND 1*b*.

Rinne's experiment with the *a*<sup>1</sup> fork is *negative* in every case.

The preponderance of B. C. over A. C. is still more marked in testing Rinne's experiment with the A fork, which, in 32 cases out of 58, was not heard at all by A. C.

Weber's experiment, when applicable with the *a*<sup>1</sup> fork, was heard almost twice as often in the *worse* ear as in the better, whilst with the A fork, it was referred almost exclusively to the worse ear.

In a portion of the cases, the duration of B. C. for the *a*<sup>1</sup> fork from the vertex was greater than mine, but in a somewhat larger portion it was less. With the A fork the excess was much more marked, except in a *single person*.

The upper tone-limit (measured by Galton's whistle) was in more than half of the cases beneath the normal, but at the maximum it was only 4.5 removed from the normal limits.

Subjective noises were present in 77 per cent. ; they were constant more than twice as often as occasional.

Disturbances of equilibrium, mostly of a moderate degree, were announced in 29 per cent. of the cases.

✓ Heredity was observed in 59 per cent.

Paracusis Willisiana was mentioned in 32 per cent.

TABLES 11*a* AND 11*b*.

Rinne's experiment with *a*<sup>1</sup>, *positive* in every case, and lasts quite long.

With a single exception, Rinne's experiment with A is positive in every case, and much more decidedly so than with *a*<sup>1</sup>. In 18 cases out of 32 A was not heard by B. C.

Weber's experiment with *a*<sup>1</sup> heard three times as often in the *better* than in worse ear, but with A it was exclusively referred to the better ear.

The period of perception for *a*<sup>1</sup> fork was never lengthened, frequently abbreviated, and six times it was 0. A was shortened in every case from the vertex or elsewhere.

The upper tone-limit was less than in one half below the normal; but rather frequently shortened to a considerable degree (10.5). Two cases of false hearing with forks are mentioned.

Subjective noises were present in 73 per cent. ; they were nearly four times as often constant as occasional.

Disturbances of equilibrium were present in 53 per cent. and Ménière's complex of symptoms present in more than one third of the cases.

Heredity was observed in 15 per cent.

Paracusis Willisiana was mentioned by one patient only (3.8 per cent.).

Childbed plays the most important ætiological part in women.

The chief causes are exposure to loud and sudden noises, syphilis, and mental overwork.

The course of the disease, with the exception of the childbed cases, is characterized by an even and gradual decrease of hearing.

The disease may begin suddenly with Ménière's symptoms, sudden relapses, and as sudden improvement of the hearing.

Children are seldom affected.

Children are seldom affected.

Most of the patients are between 20 and 40 years of age.

Most of the patients are over 40, and a large number between 60 and 80.

Men are represented by 31 per cent., women by 69 per cent.

Men are represented by 89 per cent., women by 11 per cent.

Thus we see the contrarities of the two groups. The symptoms of the first group correspond, as a whole, to those in middle-ear diseases, those of the second to diseases beyond the middle ear. This classification brings out some new differential diagnostic points, and chiefly, too, in opposition to former views, the excessive preponderance of heredity in diseases of the sound-conducting apparatus in comparison with nervous affections, and the enormous difference between the proportions in the two sexes. The latter point will be easily comprehended when we reflect upon the ætiology, and see on the one side childbed, and on the other the deafening of the ear by shooting, and a variety of handicrafts, syphilis, and mental overwork.

It is well worth noticing that all of these conditions are well represented, though not quite so forcibly, in my 1881-1883 tables,<sup>1</sup> whilst at that very time I had placed my chief reliance for a differential diagnosis between diseases of the middle and inner ear on the results of Rinne's experiment with the *a*<sup>1</sup> fork.

If we start from the explanation which I have given for the negative result of Rinne's experiment in diseases of the middle ear, viz., that in a majority of these we are to search for the cause of the preponderance of B. C. in an increased tension of the conducting apparatus at its most important point, the *ligamentum annulare*, we may expect to find, as I have presupposed, that those cases of dry sclerosing processes, as shown in Tables *Ia* and *Ib*, will show, in their

<sup>1</sup> ARCHIV. F. O., xxi., p. 221.

behavior under the tuning-fork tests, the greatest analogy amongst the affections of the middle ear, with those more or less chronic suppurative conditions of the middle ear, and their sequelæ. Indeed, it is probable that in the latter the proportion between A.C. and B.C. will reveal itself much more forcibly in favor of B.C. than is the case in otitis media simplex chronica sclerotica, because we plainly witness not only a more extensive and epidermoidal transformation and rigidity of the mucous membrane which lines the entire sound-conducting apparatus, but this apparatus is still further disorganized by other pathological alterations. For leaving aside the frequent presence of pathological adhesions at various localities, and of anchyloses in the articulations of the ossicles, every loss of radiating fibres, every perforation of the *M* must signify some disturbance in the unstable equilibrium, which so suits the normal apparatus for the reception of waves of sound, and, on the contrary, renders it less suitable for B.C., for the simple reason that in this way the tensor tympani obtains over the stapedius a preponderance that increases with the size of the perforation, and so presses the end of the chain of ossicles inward. This unstable equilibrium will be totally disturbed when portions of the chain, *e. g.*, the anvil, are entirely lost, and when the stapes is isolated, and often remains without even the tendon of the stapedius; the preceding processes in such cases, owing to their great severity, can be suspected with great probability, and further, that the fixation of the isolated stapes has become much stiffer from adhesions of one of its limbs and thickening processes at the ligamentum annulare.

When, therefore, with extensive and visible disturbances at the conducting chain, the tuning-fork tests, and especially Rinne's experiment, offer us the same results as were found in Tables Ia and Ib in diseases with negative condition, so far as our present means of investigation are concerned, we are justified in drawing the conclusion that in the latter also, in some spot inaccessible to our investigations, a pathological fixation of the sound-conducting apparatus must be present.

For the purpose, therefore, of comparison with the tables already preceding, I here offer a further table, constructed in the same fashion, to show the results of tuning-fork investigations in a series of sequelæ to middle-ear suppuration. This contains a portion of the cases that I saw in the first six months of 1886; I picked out those in which the suppuration had nearly or entirely ceased, and in which the extent of the destruction was particularly open to inspection. Most of the cases were, as in the former table, bilateral.

## III.

In these 36 ears, belonging to 10 men and 8 women, there were 26 large defects in the *Mt.*: three times the *Mt* and handle of the malleus were entirely absent; three times there was nothing left but a stump of the handle of the malleus and the *Mt* attached to it; five times the incudo-stapedial articulation with the long arm of the anvil was apparently intact, partly free, and partly enclosed in cicatricial tissue; once the same was visible, but with the long arm of the anvil dislocated; further, there were 5 cases of isolated head of the stapes, with loss of the long

TABLE III.—PERSISTENT PERFORATIONS AND CICA

No.	Age.	Side.	3 Hearing for whisper and conversation.	4 Tuning-fork a <sup>1</sup> .		5 Tuning-fork A.		6 Galton's whistle.	7 Condition of membrana tympani.
				a Rinne from mastoid.	b Weber, and duration from vertex.	a Rinne from vertex.	b Weber, and duration from vertex.		
1	19	R.	w 10 c 400	5	Undecided.		Undecided.	2.0	Total defect, except handle of hammer; stapes isolated in both.
		L.	w 9 c 300	— 5	+ 5			2.0	
2	22	R.	w 35	+ 0	+ 3	a	+ 14	2.1	Defect of post quadrant.
		L.	w 25	3		a		2.1	Defect of inferior half.
3	30	R.	w 150	+ 0	in worse.	— 8			Cicatrix in post. half.
		L.	w 100	+ 0	+ 0	— 9	+ 0		Defect of post. inf. quadra.
4	24	R.	w 20	+ 0	in worse.	a	+ 13		Defect of post. half.
		L.	w 500	+ 25	+ 3				Normal L.
5	14	R.	w 500	+ 23	+ 6	13			Normal R.
		L.	w 30	+ 7					Left: large defect in front of umbo. Calcification in anterior and inferior half.

Cases 6 to 18 omitted.—TRANS.



arm of the anvil; amongst them one where the tendon of the stapedius was also lost; 5 times the stapes was no longer visible, despite the fact that we could plainly overlook the posterior superior quadrant of the tympanum. There was a slight trace of suppuration still visible in 9 out of 26 ears.

The table also includes 6 cases of former suppuration, with extensive cicatrization in the *Mt*. In 2 of these the incudo-stapedial ligament was enclosed in the cicatrix, and in one the isolated head of the stapes.

In 4 cases, finally, the *Mt* and hearing on the other side were normal, or nearly so.

The hearing (leaving aside these 4 last cases) in 32 ears was 14 times less than 20 *Cm*, and in the remaining 18, 11 between 20 and 80, 6 between 100 and 200, 1 despite a large cicatrix, 5 for whisper.

Despite the frequent greater hearing-average of this group, in comparison with that included in tables *Ia* and *Ib*, Rinne's experiment with the *a*<sup>1</sup> fork was *negative* in every case but three, and the hearing in these was for whisper, once 30, once 150, and once 500.

TRICES IN MT AFTER OTITIS MEDIA PURULENTA.

8	9	10	11	12
Tinnitus.	Disturbances of equilibrium.	Causation.	Duration.	Duration of otorrhœa. Treatment and remarks.
Plashing sound on touching head of stapes.		Diphtheritis.	Ten years.	Insufflation of boric-acid powder improved R to 30. L not improved. Dry perforation sound R.
R constant roaring.		Scarlatina.	Seventeen years.	Otorrhœa two and a half years. Mucosa yellowish. Both ears dry, perforation sound. Politzer's experiment pushes cicatrix forward and w 350, and Rinne with <i>a</i> <sup>1</sup> + 10.
Previously constant roaring.		Otorrhœa since removal of a bean.	Since youth.	Otorrhœa still persistent though slight.
		Fourteen days since a relapse after bathing.	Seven years.	The suppuration ceased eighteen months ago after antiseptic treatment.

To tabulate, we have as follows:

1 time — a (hearing for conversation 2);

6 times between — 10 and — 12;

16 times between — 3 and — 8;

6 times + 0 (with hearing for whisper of 20, 35, 50, 100, 150, and 200 *Cm*).

Weber's experiment with the small *a'* fork was 4 times undecided (amongst these 3 with nearly or the same hearing);

11 times in the worse ear, and only once in the better ear;  
2 times there were no notes taken.

The duration for perception of T. F. *a'* from the vertex resulted:

3 times in consonance with mine;

11 times it surpassed mine by 3-8 seconds;

1 time (in a man of 56, with conversational hearing of 5 *Cm* on both sides) it was 3 seconds less than mine;

3 times notes are lacking on this point.

Rinne's experiment with the large *A* fork was tested on 30 ears, and resulted only:

1 time positive, as did the same experiment with the small *a'* fork (this was the case with incudo-stapedial articulation enclosed in a cicatrix);

17 times — *a*, and

12 times between — 7 and — 28 seconds.

Weber's experiment with the *A* fork was heard 4 times in the worse ear; 4 times it was undecided, and there are no notes in the remaining cases.

The time for which the large fork was heard from the vertex in 15 cases was once equal to mine, 13 times elongated by from 5 to 21 seconds, and only once shortened, and then by 8 seconds, and in the same case as the *a'* fork.

Galton's whistle was used 18 times, the upper tone-limit being reached and surpassed 8 times, and not reached 10 times. Two of the latter cases showed tone-gaps lying between 7 and 5, and 9 and 8 of Galton's scale.

If we compare the results of tuning-fork tests in persistent perforations and cicatrices of the *Mt* with those in Tables *Ia* and *Ib*, we find as perfect an agreement between

the two as we could on the whole expect from a method in which we must rely upon the subjective observation of the patient.

*The result of this comparison is that we gain powerful support for our theory that in every case in which Rinne's experiment results negative (except in cases of excessive difference between the hearing of the two ears) there must exist some mechanical affection of the sound-conducting apparatus, which in some way or other disturbs its unstable equilibrium.*

And, finally, the diagnostic importance of the negative result of Rinne's experiment in its bearing upon the presence of fixation of the conducting apparatus, especially of the stapes, has been anatomically confirmed by post-mortem examinations at the hands of Lucae,<sup>1</sup> Politzer,<sup>2</sup> Habermann,<sup>3</sup> and myself.<sup>4</sup>

In order to exhibit in full the results of Rinne's experiments, I excluded from the first two tables all cases of unilateral deafness, no matter whether they resulted positively or negatively. But I now subjoin them in separate tables for sake of comparison.

The number of these cases is too small to use them statistically.

We at once take it for granted that in unilateral affections those very points of support which the negative result especially gives are less reliable than in bilateral diseases. When the hearing of one ear is greatly reduced the bone-conduction of the healthy side, which cannot be excluded, especially when we test the diseased ear with the A fork, must preponderate over the remnant of A. C. in the latter, despite the presence of a nervous type of disease.

This we probably see in cases 2 and 3 in Table IV., as we may conclude from the symptoms there arrayed.

On the contrary in the remaining patients of this table, the condition seem to indicate an affection of the middle ear.

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<sup>1</sup> *Archiv f. O.*, Band xxiii., page 122.

<sup>2</sup> Siebenter Vers. Sueddeut. und Schw. Aertze.

<sup>3</sup> *Zeitschrift f. Heilkunde*, Band vii., page 361.

<sup>4</sup> Erklarungsversuch zum Verhalten der Luft- und Knochenleitung beim Rinne's V. Muenchen, 1885.

TABLE IV.—NEGATIVE RESULT OF RINNE'S

a. IN

No.	Age.	Side.	Hearing for whisper and conversation.	Tuning-fork a <sup>1</sup> .		Condition of membrana tympani.	Subjective noises.
				a	b		
1	27	R. L.	w 500 L 10	+ 25 - 4	In worse. + o	Normal.	Occasional roaring.
2	39	R. L.	w 500 w 6	+ 23 + o	In better. + o	Normal.	Constant roaring and blustering.
3	50	R.	w 500 w uncertain.	- 7	In better.	Normal.	Occasional roar- ing when ex- cited.

b. IN

1	24	R. L.	w 500 w 3	+ 17 - 6	In better. + o	Normal.	Occasional roaring.
2	27	R. L.	w 500 w 175	- 28 + o	In worse.	Normal.	
3	44	R. L.	w 8 w 500	- 10 + 21	In worse.	Normal.	

TABLE V.—POSITIVE RESULT OF RINNE'S

IN MEN

No.	Age.	Side.	Hearing for whisper and conversation.	Tuning-fork a <sup>1</sup> .		Condition of membrana tympani.	Tinnitus.
				a	b		
1	52	R. L.	w 100 w 500	+ 22 + 24	+ o	Normal.	Constant roaring and singing of birds.
2	34	R. L.	w 500 w doubtful.	+ 29 + 10	In better. + o	Exostoses in meatus.	Constant roaring.
3	39	R. L.	w 500 w 200	+ 22 + 22	In better.	Normal.	Constant roaring.
4	52	R. L.	w 500 w 80	+ 29 + 21	Undecided. + o	Normal.	
5	11	R. L.	w 6 w 500	+ 19 + 25	In worse. + o	Slight injection.	
6	38	R. L.	w 500 w 175	+ 33 + 27	Undecided. + o	Slight striated opacities.	Occasional tinnitus.
7	53	R. L.	w 200 w 500	+ 14 + 35	In better. + o	Normal.	Occasional tinnitus.
8	31	R. L.	w 500 w 30	+ 22 + 19			Normal.

EXPERIMENT, UNILATERAL AFFECTIONS.

MEN.

7	8	9	10	11
Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
Characteristic attacks of vertigo; falls in street, and invariably vomits. Begins with characteristic vertigo and emesis.	Father's brother very deaf in old age.	A great deal of headache in frontal region.  Valvular heart disease after rheumatism; sudden deafness and roaring.	Four years.	Catheter of no use. Delstanche's instrument does not move hammer. Lucae's pressure probe improves L to 18.
			Nine years.	Catheter does not improve. Hearing increased to 70 under potassic iodide. All forks heard higher. Galton's whistle 2.1 in both ears.
			Nine months.	All forks heard L by A. C. Galton's whistle 5.5.

WOMEN.

	Father deaf in old age.	Began during pregnancy. Increase of tinnitus during menses. Migraine.	Four years.	A from vertex + 10 and Rinne with A — a.
	Mother deaf in old age.		Two and a half years.	Catheter improves L to 350.
			Nine years.	Catheter bulges <i>Mt</i> . Paracentesis showed tympanum empty and normal. Successive decrease of hearing from 300 to 8. Galton's whistle R 4.2, L 2.0.

EXPERIMENT IN UNILATERAL AFFECTIONS.

EXCLUSIVELY.

7	8	9	10	11
Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
Frequent vertigo with emesis.		Transitory deafness from gunning two years before. Is obliged to shoot a great deal.  A great target shooter. Overworks a great deal. Great sexual indulgence.	Six months.	Catheter increases R to 300.
			Many years.	No improvement with catheter.
			One year.	Catheter improves the tinnitus a trifle. Rinne's experiment with A L + 26. Galton's whistle 2.0.  After Politzer's bag R 20.
Slight vertigo.			Six months.	Catheter R 200.
			One year.	Catheter with large stream increases R to 250. Six months later 125 R.

Conversely, case 7 Table V. must be one of middle-ear disease despite the positive result of tests with the  $a'$  fork, because with a hearing of 200 for whisper, the experiment although not negative, is yet abbreviated to  $+ 14$  in comparison with  $+ 35$  on the other side, and the same test with the large A fork when hearing had decreased to 125 for whisper showed  $- a$ . When the deafness is more advanced the test with  $a'$  also will result negatively. I have at least been able to confirm an analogous condition in several progressive cases in which, when the hearing was formerly better, Rinne's experiment resulted shortened but positive, whilst later with increased deafness it resulted negatively. We find, *e. g.*, four cases of this in the first table. And in these with successive gradual decrease of the hearing, and the same gradual decrease in the length of the positive result of Rinne's test until it is so finely transformed to the negative side, I see new confirmation of its diagnostic reliability.

Inversely, with tubal affections accompanied with heavy unilateral clogging of the chain of bones, and high degree of deafness, we obtain a positive result the moment that the hearing is restored, whilst at the height of the affection the experiment is emphatically negative.

In case 2 Table V., in spite of the great reduction of Rinne's experiment upon the affected side to  $+ 10$ , in comparison with  $+ 29$  on the other, yet considering the simultaneous great degree of deafness (whisper doubtful), I should urge the presence of an affection beyond the middle ear, and, indeed, the man's occupation as a hunter, and the characteristic attacks of vertigo with vomiting, would be additional objective symptoms to favor this theory.

Tables VI*a* and VI*b*, which follow, contain bilateral affections with shortened bilateral or negative unilateral result of Rinne's experiment with the  $a'$  fork, which were excluded from previous tables.

It is difficult in these cases to base any accurate diagnosis upon the result of the comparative tests between A. C. and B. C., and if we had nothing further to help us in our decision, as it is often enough the case, we should be obliged to fall

back on the term "*dysacusis*." A greater portion of the cases probably belong to an early stage of affections of the sound-conducting apparatus, like those above cited, in which, at a later investigation, the negative result of Rinne's experiment confirmed the truth of the diagnosis. In others there probably exists a complication between an affection of the middle and inner ear.

There is one fact which we discover in *acute and subacute inflammations of the middle ear* that appears to weigh heavily against the diagnostic value of Rinne's experiment; viz.: that in these most marked forms of inflammation of the middle ear, especially in *otitis media purulenta acuta*, we obtain, despite well-marked diminution of the hearing, an abbreviated positive result. Politzer discovered the same phenomenon. This was my reason for excluding all cases of this sort, both acute and subacute from consideration, provided we wish to obtain any accurate information concerning the result of the experiment in simple rigidity of the sound-conducting apparatus. It was only in this way that the desired accuracy in regard to its diagnostic importance could be obtained.

It is at present difficult to find any satisfactory explanation for this extremely different condition of some of the acute and subacute diseases.

It is possible that the acute suppurations of the middle ear with diminution of hearing for whisper and occasionally total loss for loud speech are simultaneously accompanied with an excessive inflammatory condition of the labyrinth, something like the small-celled infiltration confirmed by Moos in various acute infectious diseases.

It is also credible, on the contrary, that a serous infiltration of the mucous membrane, of the articulations, of the entire *Mt*, and of the ligamentum annulare exerts another, and perhaps an entirely opposite influence upon the mechanism of the conducting apparatus, than the simple but stiffer fixation, such as we have a right to suspect in the chronic sclerotic processes. Soaking with fluid might produce relaxation instead of tension, whereupon two forces would be working simultaneously and antagonistically upon the sound-conducting apparatus—upon one side the succu-

TABLE VIa.—BILATERAL SHORTENED OR ONLY UNI-

BILATERAL AFFECTION

No.	Age.	Side.	Hearing for whisper and conversation.	4 Tuning-fork a.		5 Condition of membrana tympani.	6 Subjective noises.
				a Rinne from mastoid.	b Weber and its duration from vertex.		
1	63	R. L.	w 450 w 200	+ 27 + 8	In worse. + o	Normal.	
2	62	R. L.	w 150 w 10	+ 25 + 12	Undecided. + o	Normal.	Constant roaring.
3	28	R. L.	w 300 w 30	+ 28 - 3	Undecided.	Normal.	Constant roaring.
4	40	R. L.	w uncertain. w 250	- 8 + 28	Undecided.	Slight folds.	Constant roaring.
5	16	R. L.	w 30 w 300	- 7 + 7	In worse.	Normal.	
6	49	R. L.	w 3 w 400	- 7 + 23	In worse. - 3	Without any light spot.	
7	48	R. L.	w uncertain. w 250	- 10 + 21	In worse. + o	Slightly opaque poste- riorly.	Roaring of late.

TABLE VIb.—BILATERAL SHORTENED OR ONLY UNI-

BILATERAL AFFECTION

No.	Age.	Side.	Hearing for whisper and conversation.	4 Tuning-fork a <sup>1</sup> .		5 Galton's whistle.	6 Condition of membrana tympani.
				a Rinne from mastoid.	b Weber, and duration from vertex.		
1	31	R. L.	w 100 w 10	+ 12 + 12	+ o		Normal. Calcification in post. and lower half. Slight opacities.
2	47	R. L.	w 25 w 35	+ 14 + 14	In worse. - 5	2.0 2.0	
3	33	R. L.	w 7 w 3	+ 9 + 9	o	2.0 2.0	Slight circumscribed opacities in post. sub-quadrant.
4	27	R. L.	w 200 l. 250	+ 19 + 17	- 5	2.0	Normal.
5	37	R. L.	w 50 w 60	+ 18 + 16	In worse. - 4	2.0	Normal.
6	63	R.	conv. uncertain.	- 10	In worse.	2.4	Normal.
7	58	L. R. L.	w 18 w 20 conv 5	+ 29 + 18 - 12	- 3 In better. + o	2.2	Posterior opacities.

Cases 8 to 11 omitted.



LATERAL NEGATIVE RESULT OF RINNE'S EXPERIMENT.

IN MEN.

7	8	9	10	11
Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
	Father deaf.		Several years.	No improvement by catheter.
			Several years.	Catheter improves R to 450, L to 12, slight decrease in last two years.
		Coppersmith. Roaring began seven months ago while at the steam hammer. Deafness after a musket was fired close beside him.	Four years.	No improvement by catheter.
	Sister, brother, father, and father's mother deaf.		Several years.	Successive decrease in four years to R 15, L 50.
2 years ago vertigo.			One year.	Rinne's experiment with A, R—a.
			Several years.	No improvement by catheter.

LATERAL NEGATIVE RESULT OF RINNE'S EXPERIMENT.

IN WOMEN ONLY.

7	8	9	10	11	12
Tinnitus.	Disturbances of equilibrium.	Heredity.	Causation.	Duration.	Treatment and remarks.
Occasional roaring.	Occasional vertigo.	Mother deaf.	Much worse after chloroform narcosis for an operation.	Three months. Since childhood.	No improvement with catheter. No improvement with catheter.
Constant roaring and drumming.			Sudden occurrence after being obliged to work after delivery.	Fourteen days.	No improvement with catheter. Much worse despite iodide and pilocarpine, and in four months conversation L at 8.
Occasional roaring.	Previously there were characteristic attacks of vertigo.			For years.	No improvement with catheter.
R constant roaring. L rapidly intermitting noises.				Thirteen years.	
Constant roaring.		Brother and niece deaf.		Several years.	Catheter does not improve. Three years later gradual decrease.
Constant roaring.		Father and grandfather deaf in old age.		Thirteen years.	Catheter improves R to 35. Two years later 15 only.

lence of the tissue, on the other, the unilateral clogging down of the *Mt* by the closure of the tube, which is here almost always present under such circumstances.

Both of these views are however opposed by the *condition of B. C. in Weber's experiment, which, as is well known, almost invariably results in favor of the diseased or the more diseased ear in all of the more acute inflammations of the middle ear.* This apparent contradiction still remains unsolved.

So much the more therefore do we need the full decisiveness of the results, as seen in the first two tables, in the chronic affections with a negative state of the parts, in order to maintain the value of Rinne's test for the latter.

Our experience may be summed up in the following short conclusions :

*The negative result of Rinne's experiment in all bilateral diseases of the ear, and in which there is not too great a difference between the hearing of the two ears, proves that some alteration is present in the conducting apparatus.*

This conclusion does not however read inversely, *i. e.*, we have no right to expect a negative result of the experiment in all cases in which the middle ear is affected. The experiment is on the contrary, much more frequently shortened, but positive, *viz.* :

1). *In the chronic conditions with negative mirror and catheter examination, and relatively good hearing (more than one meter for whisper).*

2). *In acute and subacute diseases of the middle ear, with exudation in the tympanum and despite great diminution of hearing.*

*In high degree of unilateral affections, inversely, the experiment may result negatively despite the fact that the sound-conducting apparatus is intact.*

*A normally long or but little abbreviated positive result of Rinne's experiment, with great diminution of hearing, and with otherwise negative mirror or air-douche symptoms, permits us to exclude any extensive disease of the sound-conducting apparatus, no matter whether the attack is unilateral or bilateral.*

The story told by the A fork is much more decisive in its testimony than that of the small fork, because the duration

of the negative experiment is longer, often — a, and on the contrary with a positive result it is likewise mostly elongated and frequently reaches + t. Lucae has repeatedly referred to *the remarkably good hearing for low tones by A.C.*<sup>1</sup>, and was often able in cases of decrease of the hearing from 150 to 10 Cm for whisper, to demonstrate that the fork c, which was only  $1\frac{1}{2}$  tone higher could be heard quite as long by A. C. as by persons with normal ears. He thinks that this at once excludes any essential disturbance in the sound-conducting apparatus, and assures the diagnosis of an affection of the labyrinth.

We owe to this more decided result of tests with the deep A fork, the short negative result of Rinne's experiment with A when a<sup>1</sup> is abbreviated and positive.

A positive result with A whilst a<sup>1</sup> is negative has never yet been observed, and such a possibility seems physically excluded.

The tables further confirm the fact, that the test for the perception of higher tones as recommended by Lucae, is a decided addition to our means of diagnosis, whilst Galton's whistle is admirable. With its assistance, in the same way as Burckhardt-Merian,<sup>2</sup> and Rohrer<sup>3</sup> have done, I have repeatedly discovered tone-gaps which justified us in locating the disease in the labyrinth, although of course we cannot exclude any complicating affection of the middle ear. Patients with truly labyrinthine disease more frequently exhibit a large and continuous defect belonging to the upper end of the scale.

Furthermore we frequently see a minute portion of the very highest part of the scale missing in patients whom all our other means of investigation would incline us to believe were suffering from an affection of the sound-conducting apparatus; this is especially seen in the more grievous forms of sclerotic processes, and my results in this direction coincide with those of Burckhardt and Rohrer.

<sup>1</sup> Die bei Schwerhoerigen zu beobachtende gute Perception der tieferen musikalischen Toene.—*Arch. f. O.* Band xv., page 273, and "Kritisches und Neues ueber Stimmgabelpruefung," *l. c.*

<sup>2</sup> Vergleichender Ergebnisse verschiedenartiger Hoerpruefungen.—*Archiv f. O.*, Band xxii., page 177.

<sup>3</sup> Der Rinnesche Versuch. Zuerich, 1885.

A case of ankylosis of the stapes, which I described in 1885,<sup>1</sup> may explain this abbreviation in the highest part of the scale with fixation of the conducting apparatus. The macerated bony specimen shows the stapes still in situ in the oval window, and on looking at its plate from the labyrinthine side, the inner surface is surrounded by a white smooth deposit upon the labyrinthine wall, which leaves but a small portion of the circumference around the plate free. The white deposit extends upward nearly to the border of the ampulla of the horizontal semicircular canal; *whilst downward it can be followed for some distance into the beginning of the scala vestibuli.* It has always been a source of unhappiness to me that the patient to whom this specimen belonged, though showing a negative Rinne of — 13 for a<sup>1</sup>, with hearing of 6 cm for whispered voice, was never tested for the perception of high tones. The case is analogous to those in Table I, with otherwise negative condition under local examination, and the frequent abbreviation in the highest part of the scale as there exhibited, becomes comprehensible when we assume that in the more severe cases of this group the disease, like that in our post-mortem case, takes the shape of calcification of the periosteum of the labyrinth, and then extends into the beginning of the inferior convolution of the cochlea.

It is not the purpose of this paper to emphasize the importance which the accurate differential diagnosis between disease of the middle and inner ear as obtained by Rinne's experiment already holds out for us in a therapeutical point of view, and which may gain still further with time, inasmuch as the sound-conducting apparatus, at least by improvements in operative methods, promises to become more and more accessible to us.

On the contrary, I am still called at the end of this paper to point out the new vistas which comparative tests of the diseased ear open for our knowledge of the *normal function of the sound-conducting apparatus.*

The observations of Blake and Burckhardt-Merian, that perforations of the *Mt*, loss of the hammer and anvil, may

<sup>1</sup> Erklärungsversuch, etc.

even increase the perception of high tones, prove similarly that a disease of the sound conducting apparatus in and by itself does not necessarily disturb this perception. And this, in connection with the diametrically opposite results discovered for deep tones in cases of impeded conduction of sound, leads to a physiological conclusion of the greatest importance.

Burckhardt-Merian tell us in the paper cited previously : "A certain group of aural patients of the most varying ages exhibit so excellent a bone-conduction, that even the firmest closure of both ears cannot weaken the perception for musical staffs and Galton's whistle." Again, he speaks of frequently witnessing normal hearing for these two kinds of instruments, whilst at the same time the patients are very deaf for conversation and low tones. In a case that he cites, the patient could not hear it thunder, but she could hear canary birds singing at a great distance. *Paracusis Willisiana* was also present.

I have seen the same thing in extremely deaf persons, with negative Rinne, whilst the tuning-fork could be heard longer by B. C. than in the normal ear. I have also seen patients of this sort who had never heard thunder. The very fact that despite this condition the perception for the high tones may be perfectly intact in such cases, permits us to conclude that the sound-conducting apparatus plays an inferior rôle or none at all in the transmission of this portion of the scale.

The lower portion of the scale behaves in quite a different manner toward the obstacles which disturb the unstable equilibrium of the conducting apparatus. Wollaston as far back as 1820 (*Philosophical Transactions*) observed that the deafness which is caused by too great a tension of the *Mt* is not uniform for the high and deep tones, but that under these circumstances there is only deafness for deep tones. "If he struck a table with the tip of his finger the board gave off a dull deep tone; if he hit it with his nail, a higher and more penetrating tone ensued. On rarefying the air in the tympanum, by forced inspiration whilst the mouth and nostrils were closed, he heard the latter tone (the higher) but not the deep tone. With rarefaction of

the air and increased tension of the *Mt* he could no longer hear the deep rolling sound of a wagon, but the rattling of chains and other iron work on the wagon could be easily perceived." Johannes Mueller, from whose "Handbuch der Physiologie"<sup>1</sup> I borrow the above quotation, was able to demonstrate the truth of this experiment upon himself, and explained it by the elevation of the fundamental tone for which the *Mt* is tuned.

The idea then suggested itself to me to repeat this simple experiment with the aid of tones that were pure, and whose pitch and intensity could be easily and accurately determined. I have for this purpose employed the several forks, including the two so many times mentioned, and have made the noteworthy discovery that we can *voluntarily and suddenly annihilate the tone of the large A fork whilst vibrating loud and close to the ear by rarefying the air in the middle-ear space*, as suggested above. If we next force the drumhead out by using Valsalva's experiment, the tone is heard once more in its former intensity. *We can produce this alternate disappearance and reappearance six or seven times, while the A fork is gradually dying away in front of the ear.* The tone is entirely lost until Valsalva's experiment is performed, or the tube is opened in some other way. The experiment is not wholly successful except with a fork free from overtones; *e.g.*, two of my forks a couple of octaves apart have overtones, the first one in the deeper fork being the fifth of the higher octave. Hence in forced inspiration the deep tone alone disappears, whilst the fifth is all the more distinct. The fundamental tone of the *a* fork, which is two octaves higher, must be moderately weak for it to disappear; when the *a'* fork is used, its tone is but slightly diminished by the experiment, whilst finally the experiment has no effect upon the intensity of the *a''* fork.

Mueller also finds, that deafness may be produced by artificially forcing the *Mt* outward, as in Valsalva's experiment. This can be proved for high tones,<sup>2</sup> *e.g.*, the ticking of a

<sup>1</sup> Band ii., pag. 437.

<sup>2</sup> Valsalva's experiment makes me deaf to the ticking of a watch, but this deafness ceases at once on resorting by forced inspiration, and the consequent rarefaction of the air in the tympanum; in point of fact the tension thus produced is apparently followed by an increase in the normal hearing for the watch.

watch, but not for those that are low. I am still doubtful whether the condensation of air in the middle ear, which pushes the *Mt* outward, produces tension in the entire sound-conducting apparatus or not, for it is not the tension produced on the *Mt* alone, but the terminal effect upon the ligamentum annulare, which is the decisive one. I have demonstrated anatomically,<sup>1</sup> upon the sound-conducting apparatus, that the maximal incursion of which the stapes is capable in the direction of the labyrinth, is (with opened tympanum) only one third as great as its maximum outward motion toward the tympanum, from which it seems that under normal conditions the tensor tympani with the rest of the forces which draw the apparatus inward, is just a little superior to the antagonistic action of the stapedius, labyrinthine pressure, etc., and that the action of a column of air forced against the membrane from within, is simply to resist this slight preponderance; the total effect will therefore be to relax the ligamentum annulare, whereby, as the above experiments show, we render it unsuitable for the conduction of higher, but not for that of lower tones.

The weight which is thrown upon the *Mt* by increased atmospheric pressure, such as we observe in pneumatic cabinets, acts in precisely the same manner as the artificial difference between the atmospheric pressure outside and inside the tympanum *Mt*, as caused by rarefaction of the air. Thus Mach, and Kessel,<sup>2</sup> found diminution of the lower tones with a hydrostatic pressure of 14 *Cm*, and the latter author discovered, when testing with a low (four-feet open) organ pipe, that the fundamental tone disappeared, whilst overtones were perceived.

And more than this, various tests in persons who can voluntarily stretch the tensor tympani, are almost unanimous in showing that the low tones sound smothered during the contraction of the tensor of the drumhead.<sup>3</sup>

If we now compare with these physiological conditions

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<sup>1</sup> *Arch. f. O.*, Band xvi., p. 1.

<sup>2</sup> *Sitzungsber. d. k. Academie der Wiss.*, Band lxvi., Abth. 3, 1872.

<sup>3</sup> Lucae, *Physiolog. diagnost. Beitrage zur Ohrenh.*, *Berlin. klin. Wochenschr.*, 1886, 32.

the facts which we have obtained from the previous collection of pathological alterations in the sound-conducting apparatus, Table I has shown that amongst 58 ears in which we were justified in assuming the presence of sclerotic processes in the connecting chain of ossicles, the T.F. A, free from overtones, was not heard in 32 cases by A. C. and once (with a hearing of 3 *Cm* for conversation) this was also the case with the  $a^1$  fork.

A similar state of things was discovered in destructive diseases of the sound-conducting apparatus as shown in Table III; here too the aerial conduction in 30 ears (with but partial and moderate diminution of hearing for conversation) was 17 times 0 for the large A fork, and once for the  $a^1$  fork (with a hearing distance of 2 *Cm* for conversation). The negative result of Rinne's experiment in the remaining cases permits us to assume that the A. C. for deep forks has been considerably abbreviated.

It may here be remarked that Hartmann,<sup>1</sup> in concordance with the above results, "in old cases of suppurative inflammation of the middle ear, destruction of the *Mt*, and sclerosis of the tympanic mucous membrane, and in processes which v. Troeltsch entitles "dry catarrh" or other "sclerosis of the tympanic mucous membrane," found that the c fork which he employed as a test, and which is but a small third higher than my A fork, could not be heard by A. C.

This opposite condition of high and low tones in partial or total interference with the function of the conducting apparatus compels us to acknowledge that :

*The sound-conducting apparatus serves to transmit only those waves of sound for the lower portion of the scale which strike the ear by aerial conduction ; for the upper part of the scale it is superfluous.* Whenever the function of the conducting apparatus is disturbed, the ear loses its capacity for the perception of aerial tones of the lower part of the scale, at least from A, downward, which strike it by aerial conduction.

This view, however, which arises from the above investigations, leads to a second conclusion of universal importance for the entire animal world, and at which I can only hint.

<sup>1</sup> Typen der verschiedenen Formen von Schwerhoerigkeit.



The accessory apparatus, which in the form of the sound-conducting chain only gradually is added in mammals to the percipient apparatus of the ear, indicates an extension of perception for the scale of tones by some octaves lower. This, however, does not hinder the possibility of a different arrangement of the ear in other organizations for the reception of low tones. Those animals that live under water are excluded from comparison, because waves of sound are conducted to their ears by another medium.

# THE GRAPHIC REPRESENTATION OF THE RESULTS OBTAINED BY TESTING THE HEARING WITH TUNING-FORKS.

BY ARTHUR HARTMANN, OF BERLIN.

(*With four wood-cuts.*)

Translated by J. H. SHORTER, M.D., New York.

JACOBSON, in a publication in regard to the dependence of the acuteness or the duration of hearing, gives his opinion on the method which I employ in testing the hearing with tuning-forks, *Arch. f. Ohrenkeil.*, vol. xxiv., S. 39.

As this subject is one of the most important in otology, because every method which tends to the perfection of our diagnosis enables us to give greater accuracy in our therapeutic actions, I considered it advisable to discuss the matter from an entirely objective point of view.

Jacobson in his paper compares my method with the one employed at the Berlin Otiatric University Policlinic. The method employed at that institute, according to his description, is as follows: The tuning-fork is made to vibrate by striking it in any way that one chooses, without employing any particular force, and then held in front of the patient's ear at a distance of about a centimetre ( $\frac{2}{5}$  of an inch) away from the external meatus. The patient is then asked to mention by word the moment he ceases to hear the sound. Immediately after, with the least possible loss of time, the fork is brought up close to the ear of the observer, and an estimate made of how great the acuteness of the

patient's hearing has been diminished for that particular tone by the relative intensity of the tone still audible to the observer—the same method which has been already described by Dennert in No. 18 of the *Ber. klin. Wochensch.* for 1881. Jacobson further remarks that formerly when the difference in hearing between the pathologic ear of the patient and the normal one of the observer was noted down in seconds, the numbers that were obtained were not meant to be employed as an exact criterion of the patient's acuteness of hearing, and that he had already formerly considered such a procedure as not permissible.

If then, for example, we make the tests with a tuning-fork, whose time of vibration in air is about 60 seconds, and the first patient hears the sound during 30, the second during 35, the third during 40 seconds, we obtain in this way an exact criterion of the degree of deafness in these cases; we know exactly that the second patient hears better than the first, the third better than the second, since the amplitude of the vibrations representing the intensity of the tone exactly decreases with the duration.

That the decrease cannot be considered completely symmetrical for the spaces of time concerned, from a scientific point of view, is, with reference to the laws of vibration in tuning-forks, obvious. Nevertheless, that the first ear is deafer than the second, the second deafer than the third, has been exactly determined. Jacobson proceeds in the following manner: When the first patient ceases to hear the fork he brings it up to his own ear and estimates the intensity of the sound (which the tuning-fork is still emitting). He proceeds in the same manner with the second and third patient. And now Jacobson believes that in these experiments he can appreciate every time the intensity of tone which he hears. Estimation as to the loudness or faintness of a sound is entirely dependent on the judgment of the observer. So this method has therefore no claim to validity.

The first fault which Jacobson finds in my method for testing the hearing is, that I endeavor, in opposition to the method pursued at the Berlin otiatric clinic, to determine

the absolute duration of the perception of sound, instead of determining merely the difference in duration of the perception of sound between the pathological and the normal ear. Jacobson points out very properly that the method of noting the absolute duration of the perception of sounds in determining the acuteness of hearing, is only accurate, provided the tuning-fork is struck every time with exactly the same force.

Jacobson adds that it might be assumed that Hartmann would use for his experiments tuning-forks which have some particular mechanical arrangement similar, for instance, to those which Prof. Lucae and, later on, Eitelberg have described. But as such forks have been already recommended long before by Blake, without it having been possible to introduce them into common use, Jacobson might have well drawn the conclusion that any such arrangement was worthless. I had myself for a number of years worked in the same direction—to make, according to Blake's proposal, the testing with tuning-forks a more exact method, but had soon been convinced that all theoretical considerations were useless, and that the ordinary tuning-forks perfectly satisfy the demands that we make on them in our examinations. Jacobson will arrive at the same result if, instead of theorizing, he will begin to experiment. He will come to the conclusion that the "simplex veri sigillum" holds good also in our case.

That it is possible to fix upon an average vibrating duration by simply striking the forks, Jacobson could already have inferred from the assertion of his chief, whose opinion on this question, published, for example, in *Arch. für Ohrenheilkunde*, vol. xxiii., p. 129, is as follows: "The vibrating duration of the fork (a small c fork, furnished with weights) amounts on the average to 35 seconds for air-conduction to ten seconds for conduction through the mastoid process; while for another fork of almost similar dimensions, these numbers increase up to 75 and 30 respectively."

In the same manner "Emerson,"<sup>1</sup> in his extensive exper-

<sup>1</sup> "The Testing of Hearing with Tuning-Forks," *Zeitschrift f. Ohrenheilk.*, American edition, vol. xiii., S. 53.

iments, succeeded in obtaining for practical purposes a sufficiently equal duration for any tuning-fork, by simply striking the fork on his knee.

In order to show how very little difference there is in the results obtained, by employing the method of striking the fork on a block of wood, I will give as an example two investigations made on patients—the one conducted by myself, the other by one of my assistants, Dr. Killian, regarding which I wish to lay particular stress on the fact that these patients were not particularly selected cases.

In the following tables, under the designations  $c$ ,  $c^1$ ,  $c^2$ ,  $c^3$ ,  $c^4$ , the vibrating duration is recorded for the examination by air-, as well as that for bone-conduction, and for three successive examinations, from which afterwards an average was obtained.

I.

	$c$	$c^1$	$c^2$	$c^3$	$c^4$
L	22	20	18	21	22
	23	25	17	21	18
	23	23	17	17	21
R	22	17	10	12	13
	25	13	9	15	13
	20	17	10	11	12

II.

	$c$	$c^1$	$c^2$	$c^3$	$c^4$
L	15	18	15	33	13
	15	17	17	35	14
	15	17	17	35	17
R	13	5	4	13	7
	12	7	4	11	7
	12	8	5	11	7

From such experiments, made by others as well as myself, it is evident that for all practical purposes an altogether sufficient symmetry of stroke can be obtained.

Jacobson considers as a second and even greater error than the one already mentioned, the fact that I endeavor to determine the acuteness of the patient's hearing from the results obtained by comparing the duration of the perception of sound in the good and bad ear—a proceeding to be considered as entirely invalid from a scientific point of view.

My method for testing the hearing I have described in the

following manner<sup>1</sup>: "In order to obtain, by aid of various tuning-forks, a complete picture of a certain form of deafness, I have employed the vibratory duration for the patient's ear as part of a fraction (numerator) whose denominator represents the duration for the normal ear. In my record I had made this normal duration equal to 100. If, for example, a tuning-fork that is heard by the normal ear for 40 seconds remains audible to the deaf ear for 10 seconds, then the fraction would be  $\frac{10}{40} = \frac{25}{100}$ . The formula would be as follows—40 : 10 :: 100 : x, that is  $x = 25$ . That is, in the scale which has been divided into 100 parts, 25 parts are marked off. This same method is continued with forks of different pitch; the results obtained are recorded in the same way.

Formerly I used six tuning-forks, now I only employ five in my investigations, as I find that number to be sufficient:  $c = 128$ ,  $c^1 = 256$ ,  $c^2 = 512$ ,  $c^3 = 1,024$ ,  $c^4 = 2,048$  vibrations. The low-pitched are brought to vibrate by squeezing with the fingers and suddenly letting go, the high-pitched by striking them sharply and forcibly on a block of wood. When examining a patient by air-conduction, I place the fork before the ear in such a way that the ends of the tines are held as near to the opening of the external auditory canal as possible.

When examining the bone-conduction, the fork is set perpendicularly upon the mastoid process. The best-adapted forks are those which have a vibratory duration of about 30–60 seconds for the normal ear. The average for each fork must be tested by repeated examinations on several persons possessed with normal hearing. In examining patients I find the average obtained from these consecutive tests, and these results are afterwards recorded in the scale, which has been divided into 100 equal parts.

The charts employed in recording the results of the

<sup>1</sup> The graphic representation of the results that are obtained in testing the hearing with tuning-forks. *Deutsche Mediz. Wochenschrift*, No. 15, 1885.

On the diseases of the Ear and their Treatment; 3d edition, 1885.

Types of the various forms of deafness represented graphically according to results obtained with tuning-forks of different pitch. Besides a chart for testing of the hearing.

Berlin: Fischer's Med. Buchhandlung, 1886.

examinations of cases of impaired hearing are so arranged that the upper half is used for registering the results obtained in the examination for air-conduction; the lower half for the results obtained in the examination for bone-conduction. The proportion, calculated in percentages, of the time that the tuning-fork is heard by the deaf ear, to the time determined as the average for the normal ear, is then registered in red colors in the spaces allotted for the several tuning-forks. The results obtained for bone-conduction I have not registered in their proportion to the normal standard found for bone-conduction, but have recorded these also in their relation to the average normal hearing by air conduction, as we are thus enabled to make better and more direct comparisons between the air- and bone-conduction. It must be remarked, however, that the vibratory duration is much shorter when the tuning-fork is rested on a solid body than when allowed free vibration in the air (Bezold).

The schemes obtained in this way were placed in seven different categories, and the different types of deafness were determined through the results obtained. Types I and II represent severer forms of deafness for low-pitched tones, and with varying bone-conduction, good or bad. Types III and IV severer deafness for high-pitched tones, with both good and bad hearing by bone-conduction. Types V and VI represent an equal deafness for both low- and high-pitched tones. Type VII irregular forms of deafness.

Subjoined I now give four types illustrating the results of the examination of deaf persons with different pathological changes. I have already published them in the third edition of my work, "Diseases of the Ear and their Treatment."<sup>1</sup> I still made my tests at that time with six forks, A, c<sup>1</sup>, c<sup>2</sup>, g<sup>2</sup>, c<sup>3</sup>, g<sup>3</sup>, the duration of hearing for the normal ear by air-conduction being respectively 20, 63, 45, etc. This is recorded in the middle of the chart. The vibratory duration for the pathological ear in question is recorded in figures representing the proportionate value. The spaces representing the degree of hearing for the left ear are

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<sup>1</sup> Translated into English by Jas. Erskine, G. P. Putnam's Sons, 27 and 29 W. 23d Street, New York.

Type I.

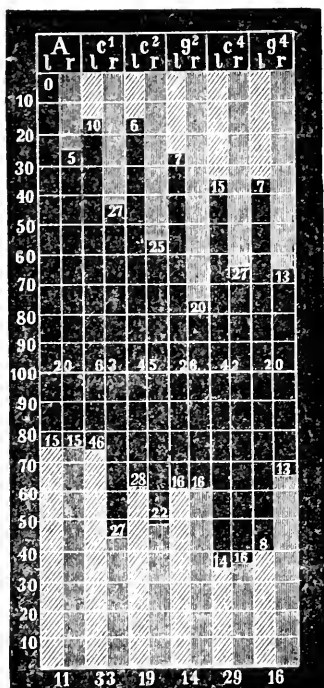


FIG. 1.

Type IV.

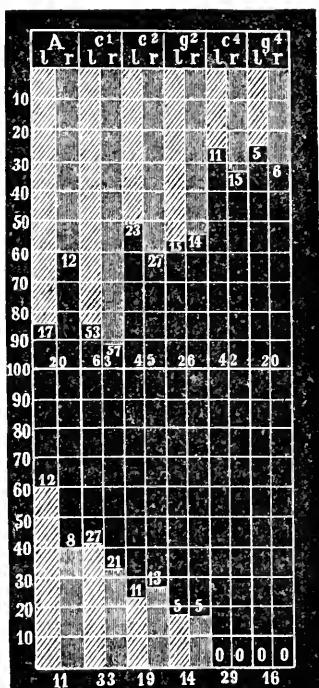


FIG. 2.

recorded in the upper half of the chart, and shaded obliquely, that for the right ear in upper half and shaded perpendicularly. At the lower end of the chart are recorded the vibratory durations for the normal ear by bone-conduction, *e. g.*, 11, 33, 19, etc. The vibratory duration for the pathological ear by bone-conduction is recorded similarly as above, and also in numbers representing their proportion to the normal hearing by air-conduction. The diagrams thus obtained are so clear and characteristic that one can immediately tell what form of deafness we are dealing with without the necessity of any further explanations.

Types I and II, representing severer deafness for low-pitched tones, were found, on the one hand, in old purulent inflammation of the middle ear, which had run its course, with destruction of the drumhead and sclerosis of the mucous membrane of the middle ear; on the other hand, in



Type V.

Type VII.

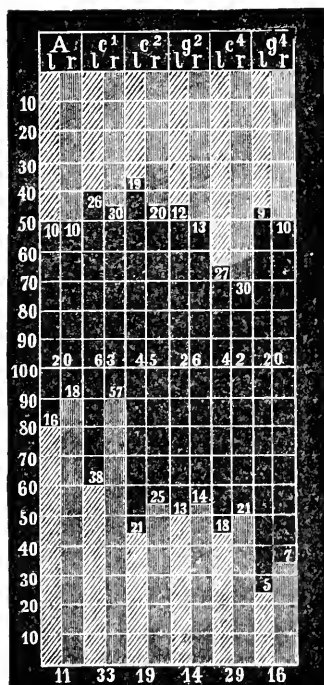


FIG. 3.

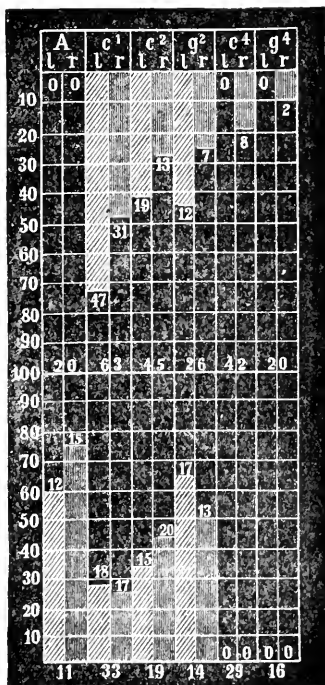


FIG. 4.

cases of so-called dry catarrh (v. Tröltzsch) or as sclerosis of the middle ear—cases in which the otoscopic examination revealed opacities and retractions, in some cases even a normal condition of the drum-membrane.

Types III and IV, representing severer deafness for high-pitched tones, were found in most cases with otoscopic examination generally showing a normal drumhead. These were cases in which, from the clinical features, along with the results obtained by this method of investigation, we could only diagnose a pathological condition of the nervous apparatus. Besides this, in a few cases of both types were found opacities and retraction of the drumhead, and in a few others acute inflammation of the middle ear was found.

To Types V and VI, representing an equal degree of deafness for different tones, belong the greatest number of cases which I examined. These types are found chiefly in

cases of middle-ear inflammation, combined with perforations and secretions; also in cases with drumhead still intact; some of them normal; some in part opaque and retracted. Furthermore, to this category belong a few cases of thrombus sabaceus, and of deafness after meningitis.

Type VII.—Irregular forms of deafness were found comparatively seldom, and in diseased conditions the most diverse, as well in cases of old suppurative inflammation of middle ear which had run their course, and of sclerosis, as also in cases in which the relations seem entirely normal, so far as could be determined by direct examination.

Jacobson makes the following objection to my method of expressing the intensity of sound through the proportion already stated, namely, that the intensity of sound diminishes not arithmetically but geometrically with the increase of the distance.

To this objection one can reply as follows: That in the same proportion as the intensity of sound is diminished when employing the tuning-fork, it also diminishes with the ordinary acoumeters, the watch, the Politzer acoumeter, or the voice, as we may employ them at different distances in testing the hearing. The intensity of the sound is always inversely proportionate to the square of the distance. Although this law should control all our judgments as to the results that we obtain by our methods of testing the hearing, it has been very little regarded by writers on otological subjects. It is not even mentioned in the hand-books of Trötsch, Politzer, or Schwartz. I have also prudently kept silent. Only in the hand-book of Urbantschitsch did I find it mentioned, and then very modestly, in fine print.

Yet the proposition of Prout and Knapp, to record the result obtained in testing the hearing as a fraction of the normal hearing distance, has been generally adopted, although this system, were we to regard the objection that Jacobson has been making, could not be used under any circumstances, as the method is scientifically incorrect. It seems that here, therefore, the practical sense of the otologists has guided them aright.

Vierordt comes also to the conclusion from a purely physiological and acoustic point of view that, "for such

very weak sounds it would be more correct to assume that they decrease in direct proportion to the distance."

The tests which I have undertaken in great number, and which can be easily repeated by others, show that they always afford comparatively characteristic results, which completely suffice for practical demands; that with it the sources of error are so restricted that they can remain unnoticed.

In the above I have been obliged to discuss theoretical topics which are still open to controversy, but I believe to have proved that my method of representing graphically the results obtained (in testing the hearing) satisfies most completely both practical as well as theoretical claims. I wish though to point out particularly that my method of representation ought not to draw forth such disputes; for it is based on the "principles of Conta" for testing with tuning-forks. The subject in question is merely as to a method of recording results obtained by pursuing a certain system of investigation. How such a record is constructed, whether the figures are merely noted down as they are found, one after the other, or in proportion to certain other quantities, makes no difference whatsoever; it is only necessary that the table represent clearly certain facts which have been found.

In criticising our methods of testing the hearing, we come to the conclusion, unfortunately, that they are all imperfect, no matter whether we use the human voice, a watch, or any other acoumeter. Science possesses as yet no instrument to measure the intensity of sound accurately, if we disregard the phonometer devised by Schafhäütl or Vierordt, which cannot be of much use for practical purposes. If we wish, which for our purposes is absolutely necessary, to test the tone-perception, we, up to this time, do not possess a more useful instrument than the tuning-fork. As soon as other more perfect instruments are devised, and which can be used just as simply, we shall be very glad to give up our tuning-fork. Until then the tuning-fork remains our most important and best working instrument. A broad judgment on the results obtained by the use of several tuning-forks can, however, only be acquired by recording the results connectedly and consecutively, in the manner that I have published.

# POLYPUS OF THE TYMPANIC CAVITY WITH IMPERFORATE MEMBRANA TYMPANI.

By A. EITELBERG.

AURIST TO THE GENERAL POLICLINIC IN VIENNA.

Translated by Dr. MAX TOEPLITZ, of NEW YORK.

**P**OLYPI of the tympanic cavity with imperforate membrana tympani are a great rarity, at least as regards the number of the existing publications of such cases. To my knowledge such a communication is made by Gottstein only.<sup>1</sup>

The case which I offer for publication is as follows :

December 3, 1885, Marie Br., fifteen years old, presented herself in my office with the statement that she was suffering for three days from continuous intense pain in the right ear. The history revealed that three years previously the patient had had a stinging sensation in the same ear for about a week, and had been troubled with tinnitus for two weeks previous to the beginning of the pain.

The examination showed the posterior part of the *Mt* to be bulged out, swollen *in toto*, partially devoid of epidermis and of reddish-gray color. Handle of malleus not discernible. In the external meatus lamellæ of epidermis were found in masses, which, of course, were removed thoroughly before the inspection of the *Mt*. With Politzer's method no perforation noise could be heard, no retrogression of the bulging following it, but the pain was greatly relieved and soon stopped entirely.

I examined the *Mt* with the probe to convince myself whether fluctuation could be detected in a *Mt*, bulged outward by a dis-

<sup>1</sup> *Arch. f. Ohrenheilk.*, vol. iv., p. 85.

charge in the tympanic cavity. I did not, however, feel any fluctuation, but a doughy resistance. This surprised me, but I ascribed it to the swelling of the membrana tympani.

As the bulging of the *Mt* persisted, I did not abstain, in spite of the absence of pain, from performing paracentesis. But in place of the supposed pus a roundish, red tumor appeared in the opening. The secretion from the mucous membrane of the tympanic cavity in the first few days was slight, but later became profuse; the perforation became markedly enlarged in the meantime. It was not until then that I could determine the seat of the polypous growth. The growth was the size of a pea, and sprang with a broad pedicle from the mucous membrane of the promontory.

Instillations of absolute alcohol, experimentally tried, produced so violent a burning sensation that the timid patient got an aversion for this remedy. Lukewarm baths with a 4 per cent. solution of boric acid, containing 10 grms of spirit. vin. rectificat. in 15 grms of aq. destill., were prescribed. I could not propose an operative removal of the growth at this time, as I was afraid that the patient would escape further observation. Besides syringing and cleansing the ear, Politzer's method also was employed in the usual manner.

In this way I treated the patient successfully. After about two weeks the discharge began to diminish and the polypus to shrink. After four more weeks it had entirely disappeared; the opening became gradually smaller and finally closed. The membrana tympani was thickened and of a whitish-gray color, the place of the paracentesis was marked by a dull shining line. The handle of the malleus remained indistinctly visible.

The hearing had improved on the right side from 0 to 10 cm for my watch; medium loud conversation was heard as far as the full length of the room (six metres), when the left ear was closed. The patient was satisfied with this result, and stopped treatment.

# ON THE QUESTION OF TESTING THE HEARING BY MEANS OF TUNING-FORKS.

BY A. BARTH, OF BERLIN.

(*With two wood-cuts.*)

Translated by Dr. MAX TOEPLITZ, New York.

AT the fifty-ninth meeting of German naturalists and physicians, after a paper by Hartmann, and on the following day after a demonstration by Lichtenberg, Jacobson, deemed it necessary, from a physical standpoint, to protest against the assumption that the power of hearing could be measured by the duration of the perception of sound from tuning-forks. I was astonished that none of the authorities who have rendered extremely valuable services in the employment of tuning-forks made any remarks either for or against this assertion, save the few words spoken *en passant* by Rohrer. When, therefore, Jacobson repeated his objection, I felt obliged to answer: "That in examinations by tuning-forks, bells, etc., repeated upon the same healthy or diseased person, concordant results are always obtained. That, in the duration of vibration, we have an available measure, is undoubted. Whether the vibrations decrease in arithmetical or geometrical progression, is immaterial."

Jacobson made opposition to this remark. My defence is as follows: First, we cannot, of course, make our examination with mathematical exactness. In this Hartmann, Jacobson, and myself agree. The main sources of error consist in the irregularity of striking the tuning-fork, and in the uncertainty to determine the moment when the sound has died away. These errors, however,

can be avoided by somewhat experienced examiners. Another error might occur through the (possibly varying) logarithmical decrement. I will even add another peculiar occurrence, namely, that according to recent investigations<sup>1</sup> the physical facts do not harmonize with physiological conditions. As, however, hardly any method of examination gives absolutely exact results, these errors are not considerable; it is sufficient that the tuning-forks vibrate equally and during the same time. In the following discussion, therefore, I presuppose, for the sake of simplicity, equal vibration, equal decrement, and a certain relation of the physiological intensity of the tone to the physical condition.

Let us now first consider, one of the more important facts of which Hartmann is said to have taken a wrong view, namely: "That the decrement of the amplitude of vibration takes place in a tuning-fork in the same manner as in every other vibrating elastic body, theoretically not in arithmetical but in geometrical progression." Every kind of vibration decreasing in any progression I can imagine as an isosceles triangle, in which the initial amplitude is indicated by the base, the duration of vibration by the altitude. I have here drawn, according to custom, and on account of simplicity, only one half of the triangle, in which  $bc$  and  $\beta\gamma$  indicate the duration of vibration,  $ab$  and  $\alpha\beta$  half the amplitude. I will now suppose, for all my following deductions, that the sounding of the tuning-fork is equally strong, namely,  $ab = \alpha\beta$ . I can understand how Jacobson imagined the subject, when comparing the arithmetical and geometrical series of figures. He apparently thinks that Hartmann is measuring the "absolute duration of perception." If Fig. 1 represents the decrement of vibration in arithmetical, Fig. 2, on the contrary, in geometrical progression, it is evident that if the patient perceives, *e. g.*, the tuning-fork during one third of the normal time of hearing, in this case  $bc$  is not equal to  $\beta\epsilon$ .

But this has not been asserted by anyone. Hartmann places the pathological duration of perception in a relation

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<sup>1</sup> Vierordt: Die Schall- und Tonstärke und das Schalleitungsvermögen. Tübingen, 1885. This number.

to the normal one, and says  $bc : bc = \beta\epsilon : \beta\gamma$ , and if we proceed further, then we have also  $ab : dc = bc : \epsilon\gamma = \alpha\beta : \delta\epsilon$ . But as  $ab$  is  $= \alpha\beta$ , we must have  $de = \delta\epsilon$ . This means: whether a tuning-fork sounds out quickly or slowly, the amplitude will always be equal in the same fractions of the duration of vibration, if the initial amplitude remains the same. This is my conception of the subject. Dr. Koenig, assistant at the physical institute of this city, with whom I have occasionally discussed this question, has kindly promised a purely mathematical argument of the subject, which will appear in one of the following numbers of these ARCHIVES.

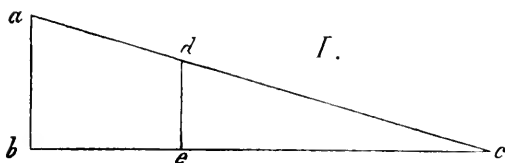


FIG. 1.

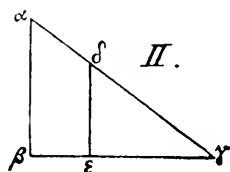


FIG. 2.

The same diagrams as the above, and the same equations, may be referred to Jacobson's remarks on the intensity of tone. For, if the amplitude decreased in any progression, and if the intensity is in a certain, known relation to the amplitude, the intensity also must decrease in the same relation. Here also, then, we have the result: With equal initial intensity it is quite indifferent whether the intensity decreases rapidly or slowly; with equal fractions of the duration of vibration the intensity will always be the same.

If Jacobson wishes further to make us believe that somebody has compared the hearing-duration of high and low-pitched tuning-forks in the same manner as he has warned against on page 41 of vol. xxiv. of the *Archiv f. Ohrenheilk.*, he is again incorrect. The examination is made with the many varieties of low and high tones as to their perception by normal and diseased ears. If we then place normal and pathological duration of perception in relation to each other, no theoretical objection can be made to comparing the results of different tones with each other.



We therefore leave the judgment of Jacobson's criticism to each individual reader. For my part I will only add, that I consider the examination with the tuning-fork the most exact of all examinations of hearing which are now practised.<sup>1</sup> It is true that it is capable of being much improved, and I consider Hartmann's suggestion a step in the right direction. Its greatest fault is that it requires much time when carefully executed. It will therefore always remain limited to certain cases only.

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<sup>1</sup> Helmholtz : Die Lehre von den Tonempfindungen, 1877, p. 14, last line a.f.

## A CASE OF NECROSIS OF THE COCHLEA.

BY A. HARTMANN, OF BERLIN.<sup>1</sup>

Translated by Dr. MAX TOEPLITZ, of New York.

THE literature of the numerous cases of necrosis of the labyrinth communicated up to date has already been compiled by Bezold in his excellent paper (*cf.* next number of these ARCHIVES), and utilized for general conclusions. Among the cases observed are very few in which the examination for hearing showed traces of remaining hearing faculty, as in the case which I now briefly relate :

Mr. T. R., student of the technical academy, after a cold, as he supposed, caught November, 1884, acquired an acute inflammation of the left ear, followed by a purulent discharge. April, 1885, a polypus was removed with the loop, followed by intense pain and paralysis of the facial nerve ; removal of polypi under chloroform with the sharp spoon is said to have also been attempted. At the end of April the mastoid process was opened with the chisel ; a communication of the opening with the external auditory meatus is said to have existed. Patient then changed his physician, and at the beginning of June a sequestrum of the size of a pea was removed from the meatus, whereupon the facial paralysis slowly disappeared. In the external meatus stenosis and granulations developed. In order to facilitate the escape of the offensive secretion repeated efforts were made to enlarge the canal, the knife and galvano-cautery being employed for the purpose. At the beginning of October, headache, vomiting and fever occurred, together with disorders of the general health. These

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<sup>1</sup> According to a communication made to the otological section of the 59th meeting of naturalists in Berlin.

symptoms disappeared after a few days. Repeated asthmatic attacks also set in.

March 25, 1886, patient came under my care; he was still very much weakened from his sufferings, which had existed a year and a half; his complexion was pale, his general health being otherwise good. There was no paralysis of the facial nerve; moderate discharge of puriform fluid, not offensive. The external meatus was extremely narrowed at the bottom, small granulations being found behind the stenosed portion. The probe detected rough bone which was slightly movable. The following day this bone could be removed with the small sharp hook. The sequestrum proved to consist of a portion of the cochlea, including about the two upper turns.

The examination of the hearing with tuning-forks showed that the patient heard the tones of seven octaves,  $c$ - $c^6$ , from the vertex on the healthy right side. From the left mastoid process nearly all of the tuning-forks were heard. On the right side it could not be determined whether the small  $c$  fork was heard on the right or left side; the  $c^1$  and  $c^2$  forks were both heard markedly stronger on the left than on the right side. Gruber's experiment, which consists in placing the tuning-fork upon the finger closing the external meatus, showed the same result, only the small  $c$ ,  $c^1$ , and  $c^2$  forks were perceived. Hence, it follows that the perception of the tones of the low tuning-forks of  $c$ ,  $c^1$ , and  $c^2$  was transferred from the mastoid process in the first, as in Gruber's experiment, to the side devoid of the cochlea. On the other hand, the high tuning-forks were heard by the patient on the healthy side. The examination of the hearing with other auxiliaries, the watch, Politzer's acoumeter, and whisper, gave a negative result. The latter was repeated at 25 *cm*, after closing the external meatus, without change of distance. To my regret I could examine the patient but once, as he was compelled to leave very soon after removal of the sequestrum. According to a subsequent communication, the discharge continued for several months under the use of iodoform, but then ceased completely under the use of boracic acid.

Among the 46 cases of necrosis of the labyrinth compiled by Bezold, there are 5, in which the examination of hearing had shown traces of remaining hearing faculty (17 Guye, 20 Cassels, 35 Christinnek, 38 Jacobson, 39 Gruber). Schwartz's case might be classed among these as:

6th. (Case 31 of Bezold's compilation) "watch is not heard, but tuning-fork from the skull by the diseased ear."

7th. In a case referred to by Lucae (*Arch. f. Ohrenheilk.*, vol. x., p. 236), in which the upper two thirds of the necrotic cochlea were removed, the large forks  $c^1$ ,  $c$ , and contra  $A$  were perceived from the occiput equally in both ears.

Kaufmann reports in a paper (On partial hearing power after necrosis of the labyrinth<sup>1</sup>) the following case from Zaufal's clinic:

8th. The exfoliated sequestrum embraced fully two thirds of the left cochlea. The watch was heard on this side in contact with the temple. From the tuberosity of the occiput the  $c$  fork was heard better on the left than on the right side. An entire scale of tuning-forks is perceived in the left ear, when placed upon the finger which occludes it.<sup>2</sup>

9th. Burckhardt-Merian,<sup>3</sup> in a patient whose necrotic cochlea was removed, could show that the tuning-fork, placed upon the vertex, was heard in the healthy ear; when the tuning-fork was displaced to the affected side the tone appeared to be on that side. When the external meatus was closed on the healthy side the tone was heard on the healthy side; when the external meatus was opened again, on the side without cochlea.

10th. The most striking case is that of Stepanow,<sup>4</sup> concerning a patient in whom about  $1\frac{1}{2}$  turns of the necrotic cochlea were removed. "The patient was examined with all tones within the limits of perception, from the lowest to the

<sup>1</sup> *Prag. med. Wochenschr.*, 1885, No. 49.

<sup>2</sup> In Czarda's case, mentioned briefly by Kaufmann, only a portion of the upper semicircular canal with the oval window was removed, so that this case may be left out of consideration. In both cases of Dennert, related by Kaufmann in his list, complete deafness existed in the affected ears, as Dennert states himself.

<sup>3</sup> Troisième Congrès internat. d'Otologie. *Compt. rend.*, p. 796.

<sup>4</sup> *Monatsschr. f. Ohrenh.*, 1886, No. 4.

highest ones; there were no tone-gaps." At the examination with the watch from the median line of the skull the watch was heard in the open ear, either the affected or the healthy one, when one ear was closed. This was also found for acoumeter and tuning-fork tones. Such a result is considered a diagnostical expedient for detecting simulation.

If we consider the different deductions of Stepanow from this point of view, we obtain a number of points of support, which make the suspicion of simulation appear not to be without foundation.<sup>1</sup>

As to the explanation for the striking result of the examination in these particular cases, I refer to Bezold's account, with which I agree in every respect. Our patients with extreme hardness of hearing or deafness on one side are not able to localize with precision. According to Kaufmann's observation, Gruber's method appears to be apt to produce such delusions as to render it hardly appropriate as a safe diagnostical expedient.

If in addition to the uncertain localization of sound we consider that by the bone-conduction, as is well known, speech, and also the tones of the tuning-fork, may be transported to the healthy ear, and if the cases in which the examination was not verified in the most careful manner, according to Dennert's method, have no convincing value, then the cases of necrosis of the labyrinth, reported in literature, in which a small amount of hearing is said to have been left, are hardly to be considered as trustworthy. Gruber<sup>2</sup> was able to prove in the most positive manner the existence of complete deafness in necrosis of the cochlea in a case in which both cochleæ were almost entirely destroyed. The examination of hearing made with the most varied expedients resulted in the fact that complete deafness existed on both sides. Until further observations free from any objection are communicated, we must cling to the view that absolute deafness is connected with necrosis of the cochlea.

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<sup>1</sup> As regards the criticism of Stepanow's case, and his explanation, or his inconclusive argumentation, I refer to the paper in question by Steinbrügge and myself, in vol. xvi., p. 245, Germ. edition of these ARCH. Moos. (Will be translated.—K.)

<sup>2</sup> *Wiener. allg. med. Zeitung.*, 1864.

# REPORT ON THE PROGRESS OF OTOLOGY DURING THE LATTER HALF OF THE YEAR 1886.

## I.—ANATOMY AND PHYSIOLOGY.

### ANATOMY.

Dr. E. C. SPITZKA, New York. Intra-axial course of the auditory tract. *New York Med. Jour.*, Sept. 18, 1886.

In the dolphin the relatively very large (hypertrophic) auditory tract has enabled the author to trace quite definitely the course of the tract from the cochlea to the auditory centre in the cortex. His observations confirm, in the main, the atrophy observations of BAGINSKY. Going from without inward, we have : 1, cochlea—2, posterior division of the 8th pair—3, trapezium of the same side ; crosses—4, part of lemniscus—5, posterior pair of corpora quadrigemina—6, internal geniculate body—7, corona radiata—8, cortex of auditory field. SWAN M. BURNETT.

### PHYSIOLOGY.

Dr. W. S. LENTE. In the physiology of hearing is there an overlapping of each auditory field, the same as in the binocular field of vision ? *Trans. Amer. Otol. Soc.*, 1886.

The author finds that there is an overlapping of the fields of audition of  $10^{\circ}$  to either side of the median line : that is, there are  $20^{\circ}$  in the median line common to both fields. The author thinks that such a condition of the auditory fields assists us in estimating the direction from which sounds proceed. S. M. B.

## II.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, of Berlin, and ED. SCHULTE, of Milan.

Translated by Dr. MAX TOEPLITZ, of New York.

### GENERAL LITERATURE.

1. Prof. BÜRKNER. Report on the cases observed at the policlinic of aural diseases, in Göttingen, in 1885. *Arch. f. Ohrenheilk.*, vol. xxiii., p. 269.

2. Dr. BRUNETTI. Cenni statistico-clinici sul primo anno di pratica otojatrìca in Venezia. *Rivista Veneta di scienze mediche*, 1886.
3. Prof. V. COZZOLINO, of Naples. Lezione sulle malattie dell' orecchio. *Napoli*, 1887.
4. Dr. SCHMIEGELOW, of Copenhagen. Bidrag til Bedømmelsen af Æresygdommens. Hjøppighed blandt Skollbøm, in Danmark. *Hosp. Tidende*, vol. iv., p. 1057.
5. Dr. V. GRAZZI, Florence. Tosse ed altri fenomeni morbosi d'azione riflessa auricolare. *Bolletino per le malattie dell' orecchio*, etc., No. 6, 1886.
6. C. J. BLAKE and T. M. ROTCH. Reflex aural symptoms without aural disease. Aural disease exciting reflex symptoms. *Amer. Jour. Med. Sci.*, October, 1886.
7. Dr. A. EITELBERG, Vienna. Otological communications. *Wien. med. Presse*, 1886.
8. Dr. A. S. WYSS. Étude clinique des complications auriculaires d'ozène. *Inaug. Dissertat.*, Geneva, 1886.
9. A. LUCAS, of Berlin. Physiologico-diagnostical contribution to otology. *Berl. klin. Wochenschr.*, No. 32, 1886.
10. Dr. C. ROLLER, Triers. On paracusis Willisii. *Arch. f. Ohrenheilk.*, vol. xxiii., p. 214.
11. Dr. JULIUS ALTHAUS, of London. On tinnitus aurium and its treatment by electricity. *The Lancet*, vol. ii., No. 7, 1886.
12. RICHARD A. D. ROBE, Glasgow. Chloroform vapor in painful ear diseases. *Brit. Med. Jour.*, November 27, 1886.
13. S. S. BISHOP. Cocaine and other anodynes in otology. *Jour. Amer. Med. Asso.*, Feb. 20, 1886.
14. PH. SCHECH. Clonic convulsions of the soft palate, with objective ear-noise following nasal neuralgia of the fifth nerve. *Münchener med. Wochenschr.*, No. 22, 1886.
15. Dr. L. JACOBSON. On the dependence of acuteness of hearing upon the time of hearing. *Arch. f. Ohrenheilk.*, xxiv., No. 1.
16. MAX. SIEGHEIM. Contributions to the knowledge of retinitis pigmentosa, with special reference to etiology. *Inaug. Dissertation*, Breslau, 1886.
17. Dr. C. KELLER, of Cologne. The care of the ears by

the school authorities. *Deutsche med. Wochenschr.*, No. 51, 1886.

18. Prof. VOLTOLINI. Some remarks on parasites in man and the higher mammals. *Monatsschr. f. Ohrenheilk.*, etc., No. 8 and 9, 1886.

1. In the polyclinic conducted by BÜRKNER 1,049 persons with 1,423 different forms of disease were treated in 1885. The operations performed in 123 cases were confined to incision of abscesses and furuncles, removal of foreign bodies, Wilde's incision, paracentesis of the *Mt*, and the extirpation of polypi. S.

2. BRUNETTI'S report on the first year of his aural practice in Venice embraces 367 ear-patients, which were seen at his polyclinic for aural diseases from July 4, 1885, to July, 1886.

3. COZZOLINO'S book contains his lectures on aural diseases and a clinico-therapeutic formulary. The author describes an ear-douche for continuous ear baths as his own invention, which corresponds to the nasal douche.

4. SCHMIEGELOW has examined the faculty of hearing of 581 school children, aged from 8 to 14 years. He divided the children into three classes: 1. Those hard of hearing: who can hear a whisper only at a distance of less than 2 metres. 2. Those hearing fairly well—at a distance of 2 to 4 metres. 3. Those hearing well—at distance of more than 4 metres.

There were in the first class . . . .	35
“ “ “ “ second “ . . . .	261
“ “ “ “ third “ . . . .	285

The pathological changes found at the examination of these children present a percentage as follows:

Inspissated cerumen . . . . .	6 %
Suppuration of the middle ear . . . .	2,4 “
(Weil found 1 %, Bezold 0.97 %).	
Chronic rhinitis . . . . .	25 “
Pharyngitis . . . . .	24 “
Hypertrophy of the adenoid tissue in the naso-pharyngeal cavity . . . . .	18 “
Tonsillar hypertrophy . . . . .	16 “

Among the so-called weak-minded children there were a great many with diminished faculty of hearing.

5. GRAZZI reports several histories of reflex symptoms in the pharynx and larynx caused by dermatitis superficialis diffusa of the external auditory meatus, otomycosis, and the presence of foreign bodies in the meatus. S.



6. The two cases illustrating the two branches of the subject are 1, irritation of the dental nerves in the bone sockets of a child of 14 months ; reflex irritation and suspense of vasomotor inhibition through the otic ganglion, causing dilatation of the tympanic vessels, pressure, and aural pain ; and 2, purulent inflammation of the middle ear in a child  $3\frac{1}{2}$  years old with reflex symptoms simulating pneumonia.

It is the opinion of the authors that the aural lesion of reflex origin has its seat primarily in the upper portion of the tympanic cavity and membrana tympani, and that this can be accounted for by the peculiar distribution of the sympathetic nerves to those parts, which is illustrated by a diagram. Reflex phenomena from the ear to other parts of the air passages are explained as follows : The irritation of the sensitive fibres of the auriculo-pneumogastric distributed in the meatus, and to the *Mt*, and is reflected along the motor fibres of the superior laryngeal nerve, exciting in the larynx the act of coughing. When the original irritant, however, involves the vasomotor fibres associated with the auricular nerve, their impression is conducted to the ganglion of the pneumogastric, and thence reflected through the sympathetic fasciculus to the first cervical ganglion ; thence through the nervi molles to the external carotid, and to the branches of the mucous membrane of the larynx. In illustration is given a case of middle-ear disease, causing laryngeal cough ; also a case of primary implication of the middle ear in pulmonary tuberculosis. The reflex influences of dentition are also considered, and the manner in which they are brought about shown. The reflex connection between the exanthemata is pointed out with an illustrative case.

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7. EITELBERG's patient, with an exudation in the middle ear, and extreme bulging of the posterior portion of the *Mt*, declined to subject himself to the paracentesis. On the evening of the same day he fell into an apathic state, which was considered a paralytic stroke by his relatives. Paracentesis and air-douche removed this condition at once.

8. Whilst Zaufal found ear diseases in 80 % of ozæna patients, Michel, Morell-Mackenzie, Loewenberg, and Moure assert that these complications of ozæna are extremely rare. Wyss has examined 60 cases for this condition ; 13 of these had no ear disease whatever, 32 were diseased in either one or both ears, but without diminution of hearing, and in 15 patients the ear

disease was accompanied by diminution of hearing. These complications were most frequent between the 10th and 30th years of age. In the first of the three above-mentioned classes the discharge was found only at the partition of the nose, not at the lateral walls. In these cases the tuning-fork in Weber's experiment was heard louder in one ear only in three cases. Rinne +, Schwabach's experiment showed 10 to 30 inches only. Acoumeter, whisper, and Galton's whistle, normal. In the second class there were found dulness, partial and complete thickening of the *Mt*, lime deposit in 1 case, and swelling of the *Eustachian* tubes in several others. The tuning-fork placed upon the vertex was heard louder on the diseased side, except in two cases, in which it was heard equally strong on both sides. Rinne +, Schwabach 5-35 inch. in 1 case 50 inch. Acoumeter and whispering weaker on the affected side than on the healthy one, but still normal. In two cases the upper limit was with Galton's whistle somewhat lower. The third of the classes mentioned above contain cases of acute catarrhal, purulent, and chronic dry middle otitis and inflammation of the labyrinth. In 6 cases the nasal disease was more pronounced upon one side than upon the other. In these the ear was diseased only upon the corresponding side. The ear diseases relapsed often, or had a chronic progressive character like the ozæna itself. There were often subjective noises; rarely pain or dizziness. A part of this class heard whispering normally, but the acoumeter showed a decreased hearing. The upper limit of Galton's whistle was in several cases abnormally low. In Weber's experiment the tuning-fork was better heard in the diseased ear. Schwabach 10-32 inch.; in two cases 45 inch. Schwabach's experiment therefore showed of 60 cases only 3 approximately normal, wherefrom the author infers that the nasal cavity of the ozæna patients loses its proper resonance on account of the discharge. The treatment of the aural diseases accompanying ozæna does not differ from the usual treatment.

9. As the inspection of the *Mt* does not give positive information as regards the tension, LUCÆ uses the insufflation noise of the meatus for the examination of the tension. He blows with the mouth into a small rubber tube placed in the ear, taking care not to blow too strongly, because the noise is thereby increased. Stronger tension of the *Mt* intensifies considerably the insufflation noise; dulness and even lime deposits

do this to a lesser degree. Less frequently the noise is deepened, at least when the *Mt* is preserved, namely, most frequently in cases of large flabby cicatrices; the deepening is increased when the *Mt* is destroyed. Diagnostically only large differences in pitch are available, as some sources of error cannot always be avoided. The author examined a patient who could contract voluntarily the tensor tympani musc. with which motion the anti-tragus was regularly approached to the tragus. When the tensor tympani was contracted the insufflation noise was increased. Lucae found also that the same patient heard the deeper sounds of the tuning-fork very much deadened when the *Mt* was tense, whilst the high notes became prominent, and *c'* was increased by the tension. This intensification of the high notes and of *c'* was also noticeable objectively.

10. ROLLER reports a case of paracusis Willisii, in which inspissated cerumen was found in the external meatus, and which was cured by its removal, in support of Politzer's supposition that this trouble may be caused by the arrested motion of the ossicles. Accordingly the author recommends the use of LUCAE's pressure-probe. S.

11. A case of tinnitus aurium in which the auditory nerve examined galvanically, after Brenner-Erb's method, proved to be in a state of simple galvanic hyperæsthesia, was permanently cured by ALTHAUS in ten sittings, by the application of rational galvanic treatment. S.

12. ROBB reports excellent results gained with vapors of chloroform in cases in which the patients complained mainly of unbearable pain. In cases of furuncle, otitis externa, diffuse and acute inflammation of the *Mt*, the pain was relieved to such an extent that the patients considered themselves cured. In many cases the pain did not return, in others all the necessary manipulations could be accomplished without causing the patient any pain. Also in cases of otalgia, without visible local signs. Robb found the vapor to be very efficient. When using the vapor the introduction of the chloroform itself into the ear must be avoided. H.

13. SCHECH examined an extremely anæmic patient who, after an injury to the nose through a fall in his sixth year, had in his twentieth year acquired a neuralgia of both sides and all branches of the fifth nerve, with clonic convulsions of the musc. levator and tensor veli palati and the azygos uvulæ, which at time of writing had existed for about three years. The soft palate was drawn

upward 40 to 100 times in a minute, with short interruptions. At the same time the anterior lip of the tubes approached and receded from the posterior one, and a cracking noise was objectively noticeable. The root of the nose was the most tender spot to pressure, but the pain could be also largely increased by pressure upon the other points of exit of the branches of the fifth, on many other points of the face, and on the *nerv. laryngeus superior*.

Besides abnormal width of the ridge of the nose, nodular scars of the skin, hypertrophy of the mucous membrane, deviation of the septum, etc., the author found that the bone of the right lamina perpendicularis and of the upper median portion of the left middle turbinated body laid bare, no signs of syphilis were discoverable. Iodide of potash was prescribed without success; cocaine, morphia, and arsenic without effect. An operation could not be considered on account of the bilateral location and the evident dyscrasic character of the disease. Of late frequent epistaxes accompanied the described condition. H.

14. SIEGHEIM found among the 73 cases of retinitis observed by Magnus five associated with deaf-mutism and six with hardness of hearing. According to Leber the ear trouble accompanying the pigmentous degeneration of the retina is most frequently congenital, but certainly of later development in several instances. It may precede the retinal disturbance. In other cases pigmentous degeneration of the retina is added later to the congenital deafness, or both appear at birth. The brothers and sisters may in addition to the retinitis pigmentosa be also affected with deaf-mutism or hardness of hearing. The author believes that the influence of consanguinity, upon closer investigation, will prove to be purely accidental, namely, that it will show itself in families which are already affected with a similar affliction. Among the 73 cases heredity was found in 17, consanguinity of the parents in 9. The relations between the retinitis pigmentosa and the deaf-mutism are composed as follows: (*a*) retinitis pigmentosa and congenital deaf-mutism are conditions closely allied; (*b*) both are hereditary in a high degree, namely, they may be transmitted as such or give birth to organic diseases in the descendants, the ectoderma being considered as the embryogenetic foundation; (*c*) with regard to the complications which are found with retinitis pigmentosa or deaf-mutism, only those organs are affected which develop from the ectoderma. H.

15. KELLER collates the various examinations of school children, as regards hardness of hearing, which have been made up to date by physicians (v. Reichard, Weil, Sexton, Moure, Gellé, Bezold), with the uniform result that 10 to 30 per cent. of the children were hard of hearing. The inquiries made by the school authorities at the request of the Prussian ministry for public instruction showed only 2.18 per cent. of the number of pupils to be affected. Keller believes it to have been a mistake of the administration for instruction to have discarded medical advice. H.

16. In addition to the presence of an acarus (a new species of dermatonypos) observed by himself in the ear of the adult cattle, VOLTOLINI compares the cases published by other authors, in which *Sarcophila Wohlfartii* was found in the auditory meatus and in the nose. The danger caused by the maggots of that insect when it enters the nose, is illustrated by the patient's history. The destructions produced in this case by the maggots in the nose and the nasal cavities, caused the death of the patient referred to. S.

#### INSTRUMENTS AND APPARATUS.

17. Dr. T. PINI, Milan. Il catetere pneumo-elettrico Eustachiano. *Gazz. degli Capitali*, No. 14, 1886.

18. Dr. SCHUBERT, Nuremberg. A galvanocauter for the membrana tympani. *Arch. f. Ohrenheilk.*, vol. xxiv., p. 47.

19. Dr. RATTEL, Paris. Des cornets acoustiques et de leur emploi dans le traitement médical de la surdimutité. Ballière et fils, 1886.

20. Dr. BÜRKNER, Göttingen. The availability of Auer's incandescent gaslight for medical purposes. *Berl. klin. Wochenschr.*, No. 48, 1886.

17. Description of a new *Eustachian* catheter, available at the same time for the execution of electric procedures in the *Eustachian* tube and the tympanic cavity, and also for the air douche. S.

18. SCHUBERT recommends, in place of the usual pointed burners, making only a round and comparatively small perforation, a burner 3 mm long, devised by himself, the cutting edge of which is placed vertically to the handle, which produces larger openings in the *Mt*. The inclination of the burner to the handle

must be adapted to the inclination of the *Mt*, which varies according to age and individuality. S.

19. RATTEL's monograph, after an historical introduction, describes a great number of hearing tubes variously recommended. The varieties and the number of the instruments prove that the problem of the prosthesis for the ear has not been solved as yet. The indication for the employment of hearing-tubes exists in most of the diseases of the conducting apparatus. In affections of the nervous apparatus they are inapplicable. The severer the lesions in the ear are the larger must be the apparatus, and the conductivity of its material must be greater. Various experiments must be made in order to find a suitable tube. H.

20. BÜRKNER recommends especially for examination of the ear and nose Auer's incandescent gaslight; a cotton tissue, impregnated with nitrates of Cer, Yttrium, Didym, Lanthan, etc., glows in a Bunsen burner. Advantages: white, bright, steady light, slight heat, expenses small, amount of consumed gas half as much as with the ordinary burners. H.

#### EXTERNAL EAR.

21. DR. MÉNIÈRE. Epaissement hypertrophique des deux pavillons des oreilles. *Bull. et mémoires de la Soc. Franç. d'Otologie*, etc., vol. iv., p. 42.

22. W. C. PIPNIO. Naevus vascularis maternus. *Med. Record*, October 16, 1886.

23. THOMAS R. POOLEY. A case of epithelioma of the auricle, *Med. Record*, November 20, 1886.

24. DR. SHIRMUNSKI, St. Petersburg. A case of complete cicatricial closure of the aural introitus. Restitution of opening and hearing. *St. Petersburg. med. Wochenschr.*, 1886, No. 34.

25. I. E. MURRELL. Black cerumen. *Journ. Amer. Med. Assoc.*, October 2, 1886.

26. G. DOBNEY. Furuncle of the external ear. *Progress*, July, 1886.

27. Prof. JOSEF GRUBER. On the occurrence and signification of yellow spots on the membrana tympani in the vicinity of the end of the handle of the malleus. *Monatsschr. f. Ohrenheilk.*, etc., 1886, No. 7.

21. MÉNIÈRE observed in a man, 34 years old, without syphilitic or other diathesis, a hypertrophic thickening of both auricles,

which developed on both sides during the last two years. There were no signs of inflammation. H.

22. The growth was on the helix of the right ear, and it began to enlarge rather rapidly after the first year. Electrolysis was tried without avail, and it was finally removed by the knife. It measured  $2\frac{1}{8}$  by 1 inch, and was  $\frac{5}{8}$  inch thick. The mother stated that when carrying the child she had occasion to separate a dog from an old sow's ear, which was lacerated and bleeding.

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23. The patient was a man who first noticed some scales on his right ear, five years before the operation, following a frost-bite. The "wart," which gradually formed after this, was removed by a physician at the beginning of the fifth year, and pronounced, after examination, to be non-malignant. At the time P. saw him there was rather a deep, ragged-edged ulcer on the anti-helix,  $\frac{1}{2}$  by  $\frac{3}{8}$  inch in size. The submaxillary glands were enlarged. The growth was enclosed in an entropium forceps, cocaine injected subcutaneously, and the whole diseased tissue removed. There has been no return of the growth now two years since the removal. S. M. B.

24. SHIRMUNSKI reports a case of a female patient, 21 years of age, in which membranous occlusion of the external meatus occurred after scarlatinous otorrhœa in childhood. A previously-performed operation had proved unsuccessful. The introitus, when examined, was found to be occluded by a radiating cicatricial membrane. When touched with the probe, the membrane appeared to be somewhat yielding in the centre. The examination of hearing showed that the labyrinth could not have been changed to a great extent. The operation was performed with a pointed bistouri, which had to penetrate the cicatricial tissue 5 to 6 mm in order to reach the extremely narrowed lumen of the meatus. A transverse incision was added, and at last the cicatrix was destroyed with the galvano-cautery. After gradual dilatation with tents during two weeks, a speculum of medium size could be easily introduced. Thickened masses of epidermis and pus were removed from the meatus. A small perforation with granulations was cured with chromic acid. A small rubber tube had to be introduced a few weeks longer, in order to prevent reunion, until complete healing had taken place with a permanent opening.

H.

27. The cerumen was soft like treacle and as black as tar.

There were no vegetable spores found in it under the microscope nor any pigment granules. The coloring matter seemed to be of a soluble nature. The ears appeared to be healthy. No explanation is attempted. S. M. B.

28. The patient, a man of fifty-nine years, had suffered great pain for several days from a furuncle in the left meatus. It was incised and a few drops of pus were discharged. A few moments thereafter he became dizzy, then unconscious and delirious, and went into tonic convulsions consisting chiefly of opisthotonos. By the next morning he had recovered. He reported that he had had a few "fits" after an injury to the head in childhood, but none since. S. M. B.

29. GRUBER describes yellow spots near the lower extremity of the handle of the malleus, which must be differentiated from those which occur normally and must be considered as pathological lesions of the membrana tympani. These may arise from the collection of a colloid-like fluid which has settled in a small quantity between the layers of the *Mt*, and they are then disc-like or of less regular outlines. Besides this, spots may also indicate the formation of folds in this part of the *Mt*, together with partial relaxation of the membrane. Both forms of yellow spots are observed by the author only in cases of sclerosis in the middle ear with extreme retraction of the *Mt*. S.

#### MIDDLE EAR.

30. S. S. BISHOP. Cocaine and other anodynes in otology. *Journ. Amer. Med. Assoc.*, Feb. 20, 1886.

31. C. H. BURNETT. The local use of cocaine and brucine in diseases of the ear. *Trans. Amer. Otol. Soc.*, 1885.

32. W. A. BARTLETT. The effect of sea-bathing on the ear. *Med. Record*, Aug. 28, 1886.

33. GORHAM BACON. Two cases of ear diseases due to traumatism. *Trans. Amer. Otol. Soc.*, 1886.

34. DR. GELLÉ. Trois cas d' otite hémorrhagique. *Revue mens. de laryngol.* etc., No. 12, 1886.

35. ALBERT H. BUCK, New York. On painless or only slightly painful ulceration and perforation of the membrana tympani, probably of a tubercular nature. *New York Med. Jour.*, Aug. 21, 1886.



36. BROOKS. A case of pent-up pus in the tympanic cavity. *Brit. Med. Jour.*, December 11, 1886.

37. SAMUEL SEXTON. The diagnosis and treatment of acute and chronic purulent inflammation of the middle-ear tract and their complications. *Trans. Amer. Otol. Soc.*, 1886.

38. S. S. BISHOP. Operations on the drum-head for impaired hearing, with fourteen cases. *Jour. Amer. Med. Assoc.*, August 28, 1885.

39. HUNTINGTON RICHARDS, New York. A singular case of mastoid disease, spontaneous perforation in an unusual situation. *Med. Record*, December 11, 1886.

40. B. GOWERS and E. BARKER (University College Hospital) London. On a case of abscess of the temporo-sphenoidal lobe of the brain due to otitis media successfully treated by trephining and drainage. *Brit. Med. Jour.*, December 11, 1886.

41. W. H. BAKER. Otitis media. *New York Med. Jour.*, November 13, 1886.

42. C. H. BURNETT. Two cases of chronic purulent inflammation of the tympanic attic, treated with peroxide of hydrogen. *Trans. Amer. Otol. Soc.*, 1886.

43. SAMUEL SEXTON. A new operation for the radical cure of chronic purulent inflammation of the middle-ear tract. *Trans. Amer. Otol. Soc.*, 1886.

44. M. BONNET. Otite purulente après un accouchement. Phlébite des sinus. Pyohæmie. Mort. Autopsie. *Annales des malad. de l'oreille*, etc., No. 9, 1886.

45. O. D. POMEROY. A case of abscess of the mastoid cells where the main indication for operation was elevated temperature. *Trans. Amer. Otol. Soc.*, 1886.

46. Dr. I. W. HULKE, London. Trephining for evacuation of intracranial abscess occurring in connection with suppurations in the ear. *The Lancet*, vol. ii., No. 3, 1886.

47. A. LUCÆ and L. JACOBSON. Hundert Fälle von operativer Eröffnung des Warzenfortsatzes (A hundred cases of operative opening of the mastoid process). *Berl. klin. Wochenschr.*, 1886, No. 38.

48. Dr. H. BIRCHER, Aarau. Zur Eröffnung des Warzenfortsatzes (On the opening of the mastoid process). *Correspondenzblatt f. Schweizer Aerzte*, 1886.

49. Dr. M. GRÖNLAND, Copenhagen. Resection of processus mastoideus for suppurativ otitis media. *Hosp. Tidende*, vol. iii., p. 653.

50. ALBERT H. BUCK, New York. On certain technical details relating to the mastoid process and the after-treatment. *Trans. Amer. Otol. Soc.*, vol. iii., part 5, p. 623.

51. H. KNAPP. Fatal termination after chiselling of the bone in a case of sclerosing mastoiditis. *Trans. Amer. Otol. Soc.* 1886.

52. Dr. WEINLECHNER, Vienna. Osteoma in the mastoid region removed by operation, etc. *Monatsschr. f. Ohrenheilk*, etc., 1886, No. 11.

53. Dr. NOQUET, Lille. Crises epileptiformes provoquées par une otite moyenne chronique simple. *Revue mens. de laryngol.*, etc., No. 7. 1886.

30. The author reports that he has been able to subdue the pain of acute otitis media with an intact membrane, by instilling a 4 % solution of cocaine into the meatus and allowing it to remain in contact with the membrane for five minutes. The pain, he says, seldom returns after the first application.

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31. The author has not found the sulphate of cocaine of any value in relieving the pain of otitis media or externa. The hydrochlorate has been somewhat efficacious, but only in superficial congestion of their tissues. He has used brucine in several cases, however, with decided relief to the pain, and particularly in otitis externa, it apparently anæsthetizing the skin more promptly than the mucous membrane. He used it in 5 % solution.

S. M. B.

32. Of seven acute cases presenting at Dr. SEXTON's clinic all were males. In four the ears had been injured by water passing into the middle ear *via* the *Eustachian* tube. In the others, the injury came from the water entering the external meatus. In five cases the inflammation was limited to the attic of the tympanum and contiguous parts, and there was no discharge from the ears. It is advisable for bathers to put some cotton in the external meatus before going into the water.

S. M. B.

33. Case I. Injury to membrana tympani from the twig of a tree. Case II. Pistol-shot wound of the right mastoid process. The bullet entered the mastoid and lodged against the posterior

wall of the external meatus, causing it to bulge forward and to necrose. Some spiculæ of bone were removed through the meatus, and the mastoid was trephined, and an attempt was made to extract the ball; as the patient behaved badly under the ether it had to be abandoned. A second attempt was not made. The patient disappeared from view, but his hearing-power had increased, and the wound in the mastoid made with the trephine had quite healed.

S. M. B.

34. GELLÉ reports three cases of hemorrhagic otitis which followed a severe inflammatory course from beginning to end. In all three cases the inflammation was associated with epistaxis. Gellé thinks it to be quite possible that blood enters the middle ear through the *Eustachian* tubes during the epistaxis. This hemorrhagic attack may also arise both in the ear and in the nose.

H.

35. BUCK makes, from three observations, the following conclusions concerning the characteristic appearances of tuberculous inflammation in the middle ear in the first stage: 1. The tendency of the process to localize itself near the upper and posterior portions of the *Mt.* 2. Marked insignificance of pain, or even its entire absence. 3. The intolerance of any but the simplest and gentlest local remedies.

H.

36. BROOK's patient suffered since childhood from scarlatinous otorrhœa; fever, intense headache, dizziness, and temporary loss of consciousness ensued. After his admission to the hospital the patient was without consciousness for a week, and in addition a facial paralysis supervened. Field was consulted. After removal of a large polypus a considerable amount of pus was discharged from the tympanic cavity, with immediate relief of the symptoms. The facial paralysis disappeared the following day.

H.

37. In these statistics there are included 2,366 cases, selected from over 20,000 cases. Of these, 739 were acute purulent inflammation, 245 acute catarrhal inflammation, and 1,382 chronic purulent inflammation. The principal active causes of the acute purulent cases were: syphilis in 7 cases, sea-bath in 75, traumatism in 34, maltreatment of chronic purulent inflammation in 34, exposure in 27, exanthemata in 19. In the acute catarrhs the active causes were: syphilis in 3 cases, sea-bath in 48, traumatism in 15, exposure in 9, exanthemata in 8. In the chronic purulent cases the active causes were: syphilis in 23 cases, sea-bath in 81,

traumatism in 27, maltreatment in 15, exposure in 7, Turkish-bath in 3, exanthemata in 189, vaccination in 2, diphtheria in 8, croup in 1, small-pox in 2, pertussis in 4, parotitis in 1, typhoid-fever in 3, pneumonia in 1.

Among these cases there were 119 cases of mastoid disease in the acute cases, and 71 in the chronic cases. In 131 cases of acute and chronic suppurative inflammation of the middle-ear tract, there was periostitis interna or externa, or both, with caries of the auditory plate, and mastoid antrum, and other grave complications. Of these, 12 terminated fatally. A synopsis of these fatal cases is given. This is followed by some remarks on the anatomy of the ear, giving Prof. Leidy's latest investigations on that part of the temporal bone belonging to the middle ear. Some space is given to the question of trephining the mastoid process. The author, as is well known, is much averse to this operation, maintaining that it is easier and better to obtain the proper discharge of the mastoid cavity through the external auditory meatus.

S. M. B.

38. A piece of the *Mt* was taken out, but in no case were the ossicles removed, and they were all cases of chronic non-suppurative catarrh. In none was any evil result experienced, though in three, suppuration of the middle ear followed the operation. The improvement in hearing was not great in any case, but nearly all expressed themselves as hearing better.

S. M. B.

39. RICHARDS' patient, after a cold, acquired an inflammation of the middle ear, involving the mastoid process. A small perforation of the membrana tympani had to be enlarged repeatedly, and Wilde's incision was employed. Gradually a swelling, soon presenting fluctuation, developed behind the mastoid process at the connection with the occipital bone; pus was discharged from the opening of the *Mt* upon pressure on the swelling. After the incision a great deal of pus was discharged, and injected fluids passed through the nose. The probe entered the mastoid process through thin osseous layers. The injections were followed by headache and vomiting. Gradual improvement. Cure eighteen days after the incision.

H.

40. GOWERS and BARKER report an extremely important case of a patient, nineteen years old, affected since childhood with an otorrhœa of the right side, which had developed after scarlet-fever. In August, 1886, pain began in and around the ear with disorders of the general health; at the beginning of September

signs of fever. At the admission to the hospital (September 15th) no disorder of the central nervous system existed, but bilateral neuritis optica. Offensive suppuration from the ear. In the membrana tympani a large perforation existed anteriorly above ; firm, foetid, cheesy masses behind it ; no signs of inflammation. Gradual increase of the neuritis. September 25th slight dazed condition, vomiting, unequal pupils, no headache ; September 28th chiselling of the mastoid process, irrigation towards the external meatus, removal of cheesy masses. The general symptoms improved after the operation, there remained different reaction of the pupils and increase of the neuritis optica. The fourth day after the operation vomiting set in again, increasing stupor, sleepless nights, delirium, when syringed nystagmus to the left on both sides, higher fever with chills. On October 3d it was decided to search for an abscess in the temporal lobe ;  $1\frac{1}{4}$  inches behind and  $1\frac{1}{4}$  inches above the centre of the external meatus (at the lower posterior angle of the parietal bone, near the squamous suture) the skull was opened with the trepan. The dura mater and the surface of the brain were both found normal. The wound was washed with a strong solution of carbolic acid and dusted with iodoform. An aspiration needle was then introduced into the temporal lobe, taking an inward, forward, and downward direction. When the needle had entered about one half inch from the surface of the brain, a peculiar noise, produced by the escape of a gas bubble, was heard, followed by the discharge of  $4\frac{1}{2}$  drs. of thick, yellow, and very offensive pus. After removal of the needle the opening was enlarged with forceps and 2 to 3 drs. more of pus were discharged. The brain cortex was then removed with Volkmann's spoon to the extent of the size of the external opening. Introduction of a rubber drainage tube, two inches long, dusted with iodoform, dressing with iodoform gauze. During the operation no nervous symptoms appeared. Respiration impaired once, but improved with the escape of the pus from the abscess. At the same time the pulse rose to 150. The after-treatment consisted in regular irrigations with solution of boric acid, a silver drainage tube being later substituted for the rubber tube. After the operation rapid improvement of all symptoms ; improvement of the optic neuritis. The day following the operation the pus escaping from the abscess cavity had lost its offensive smell. Two weeks after the operation the drainage tube was omitted and the patient allowed to get up, and

November 12th was discharged from the hospital completely cured.

BARKER lays much stress for the success of the operation upon the previous thorough disinfection of the middle ear and its accessory cavities. In order to determine whether the seat of the intracranial suppuration is in the cerebrum or in the cerebellum, BARKER during the operation searched for the foramen of the vena mastoidea, in the belief that the pus when perforating towards the posterior surface of the petrous bone has first to form a layer between dura mater and petrous bone, from which pus escapes through the foramen mastoideum. H.

41. The author inveighs against the new operation (removal of the ossicles) for "the radical cure of otitis media." In a series of fifty cases of all forms and severity he has found boric acid almost a specific. S. M. B.

42. The first case was that of a man thirty-seven years old, who had at intervals for four years been under observation and treatment for attic disease, the *Mt* being intact below Shrapnell's membrane. The usual methods of treatment did not seem to make any permanent impression on the diseased condition. Finally the peroxide of hydrogen was used as a cleanser, and the condition has vastly improved, and the hearing power has increased from 0 to 3 feet for the voice.

In the second case the *Mt* was gone, but the roof of the attic was diseased. The cleansing of the parts with the peroxide and application of a carbolic acid solution of 5 % caused a cessation of the discharge, which had existed pretty constantly since childhood. S. M. B.

43. This operation consists in cleaning out the tympanum of all the remains of broken-down tissue, particularly the membrana flaccida and the contents of the attic. The malleus and the incus when detached are also removed. A knife and some scrapers used in the operation are figured. S. M. B.

44. BONNET. Still-birth; mother well, then rigors with perspiration and intense headache. In the evening violent pain in the left ear and mastoid process. The following days continuous chills, repeated epistaxis, purulent discharge. Wilde's incision. Chills become irregular, the temperature rises to 42.2°. Death ensues 23 days after the first chill. The post-mortem examination reveals a large abscess and several small miliary ones in the lung. In the cranial cavity no pathological changes except congestion

were found in the brain and the meninges. The left lateral sinus shows yellow-green discoloration ; its contents are transformed into a pus cavity. No suppuration in the mastoid process. The author considers the inflammation of the middle ear as the part primarily infected from the uterus, whilst the sinus and the lung are supposed to be affected secondarily from the ear. H.

45. The patient, a man of 20, had acute otitis purulenta media. Soon after cessation of discharge there was a sudden elevation of temperature ( $103\frac{3}{4}^{\circ}$ ), some slight tenderness over the mastoid, but no swelling or redness. It was decided to perforate. The external layers of bone were healthy, but the drill finally struck a cavity containing 5 or 6 drops of thick pus. All the unpleasant symptoms immediately subsided. S. M. B.

46. HULKE, on account of his latest experiences on the seat of brain abscesses following suppurations of the middle ear, believes that in young individuals the abscess is located more frequently above the tentorium cerebelli, in older persons below this. Hemiplegia and hemispasms are in favor of the upper location, symptoms of pain being absolutely unavailable for the differential diagnosis. S.

47. Among the 100 operated patients 57 were cured, 31 remained not cured (partially improved), 12 died, one of them independently of the ear disease. In no case did death ensue in consequence of the operation. In all, 16 were operated for acute inflammation of the mastoid process without cutaneous abscess, 37 for subcutaneous or subperiosteal abscesses, 41 for fistulæ of bone, 24 for fistulæ of bone and skin, 23 with apparently healthy mastoid process ; in 25 cases an *indicatio vitalis* was present—8 of these 25 died. The operation was made with chisel, hammer, and sharp spoon exclusively. The sinus transversus was laid bare in 8 cases without injury, the dura mater in 1 case. The after-treatment consisted in irrigation of 1-2 % solution of carbolic acid, plugging with iodoform gauze, and draining with small rubber—and later lead—tubes. H.

48. Mastoiditis is rarely, although occasionally a primary disease. BIRCHER observed 3 such cases running a favorable course without operation. In secondary inflammation the acute and the chronic are to be distinguished from each other, and practically the simple retention of pus ranks equally with these. In operating, an incision in the skin is made 1 cm behind the auricle. This incision often meets with a subperiosteal abscess. But in almost

all cases there is another abscess at the bottom which must also be opened. After removal of the pus the wound is disinfected, drained, cutaneous wound sewed, and every second or third day irrigated with disinfecting fluid. The dangers of the operation consist in injury to the facial nerve, the transverse sinus, and the opening of the cranial cavity. The injury to the facial may lead to permanent lesions. The opening of the cranial cavity, with careful antisepsis, is without danger. The injury to the transverse sinus is the most dangerous, but often even this is without ill effect. In one case the sinus was opened by BIRCHER without detrimental consequences. H.

49. The operations were performed in the municipal-hospital in Copenhagen, ten by Prof. Studsgaard, one by DR. E. Tscherning, all with excellent result. In one case the transverse sinus was opened, the bleeding was stopped by compression; from the same patient—a girl, two years old—a piece of the labyrinth was removed through the operation wound.

50. The author points out what he considers to be the superiority of the drill over the chisel or gouge in perforating the mastoid. He thinks that chisels require more skill, that they produce a larger area of depressed bone, and that statistics do not show that the chiselling is followed by any more favorable results. He gives in addition the detailed history of 24 operations of this character, 8 of which have not been hitherto published. S. M. B.

51. The patient was a man 50 years old, and the operation was performed for sclerosing mastoiditis. He died on the 4th day after the operation, with what the author believes to have been a traumatic meningitis. No autopsy. In his opinion, the operation is not advisable in cases where it is likely that old suppurative disease has locked up inaccessible foci of old, decomposed pus.

S. M. B.

52. WEINLECHNER removed with hammer and chisel an ivory osteoma, weighing 30 grms., from the mastoid process of a woman, 30 years old. During operation the mastoid cells were opened, whereupon a suppurative otitis media with perforation of the membrana tympani set in, which did not prevent a complete healing with recovery of the normal hearing faculty. S.

53. NOQUET, in a patient, 41 years of age, suffering for more than a year from frequently returning epileptic attacks, found hardness of hearing on one side without patient being aware of it. This was due to chronic simple catarrh of the middle ear,



with retraction of the *Mt* and of exudation in the tympanic cavity. Suitable treatment cured the ear disease and relieved the patient from his epileptic attacks. H.

## NERVOUS APPARATUS.

54. Dr. DÉLIE D'YPRES. Surdit  et logopl gie par suite d'un coup sur la r gion occipitale. *Revue mens. de laryngol.*, etc., 1886, No. 10.

54. DÉLIE's patient, 13 years of age, after a severe blow with a stick upon the occiput, was without consciousness for two minutes; from that time did not talk any more, and was completely deaf. There existed no headache, no disorder of vision, no giddiness, no vomiting, nor tinnitus. Clear intelligence, excellent memory. Patient answers written questions in the same manner or by signs. Simulation could be excluded. A week after the injury, improvement of the hearing, which gradually increased. Two months later the patient fell into the water, whereupon the speech returned. After three days the hearing also was completely restored. H.

## NOSE AND NASO-PHARYNX.

55. E. CRESWELL BABER. Examination of the nasal cavities from the front. *British Med. Jour.*, Dec. 11, 1886.

56. Dr. A. HEDINGER. Ueber Rhinochirurgie (On nasal surgery). *W rttemberger med. Correspondenzblatt*, 1886, Nos. 32-34.

57. Dr. ANTONELLI. Il sublimato corrosivo nella rinite ulcerativa. *Bolletino delle malattie dell' orecchio*, 1886, No. 5.

58. Dr. A. HOLM, Copenhagen. Nogle Tilf lde of anosmia syphilitica. *Hosp. Tidende*, vol. iv., p. 649.

59. Dr. KRIEG, Stuttgart. Resection der cartilago quadrangularis septi narium zur Heilung der Scoliosis septi (On resection of the quadrangular cartilage of the nasal partition for the cure of deviation of the septum). *W rttemberger Med. Correspondenzblatt*, 1886, No. 28.

60. Dr. WOLTERING, M nster. Operation einer kn chernen Nasenverengerung mittelst schneidender Knochenzange (Operation of an osseous nasal stenosis by means of the cutting bone-forceps). *Monatsschr. f. Ohrenheilk.*, 1886, No. 10.

61. Dr. SCHMIEGELOW, Copenhagen. Reflex neurosernes Forhold til Sygdomme in N sen og Sv lget. *Nord. med. Arkiv.*, vol. xvii., p. 27.

62. Dr. ZIEM, Danzig. Ueber neuralgische und nervöse Begleiterscheinungen bei Nasen- und Rachenkrankheiten (On neuralgic and nervous complications in diseases of the nose and pharynx). *Monatsschr. f. Ohrenheilk.* 1886, Nos. 8 and 9.

63. Dr. L. LICHTWITZ, Bordeaux. Des zones hystérogènes observées sur la muqueuse des voies aériennes supérieures et des organes des sens. *Revue mens. de laryngol.*, etc., 1886, No. 12.

64. Prof. VOLTOLINI, Breslau. Ueber electrolytische Operationen mit Demonstration von Instrumenten (On electrolytic operations with demonstration of instruments). *Monatsschr. f. Ohrenh.*, 1886, No. 10.

66. Dr. GELLÉ. Epistaxis grave, tamponnement postérieur. Otites suppurées bilatérales. *Revue mens. de laryngol.*, etc., 1886, No. 12.

66. Dr. SCHMIEGELOW, Copenhagen. Quelques cas assez rares de perforations de la cloison nasale. *Revue mens. de laryngol.*, etc., 1886, No. 11.

67. EDWARD BOVILL. A case of rhinolith. *British Medical Jour.*, Oct. 16, 1886.

68. HENRI CHATELLIER. Note histologique sur deux tumeurs mucoïdes de l'extrémité pharyngienne des cornets inférieurs. *Annales des malad. de l'oreille*, etc., 1886, No. 8.

69. HENRI CHATELLIER. Note sur un cas d'hypertrophie de la muqueuse nasale. *Ibid.*, 1886, No. 9.

70. Dr. ALBERT CLAVERIE. Études sur les tumeurs malignes primitives des fosses nasales. Bordeaux, 1886.

71. E. S. MOURE. Sur un cas de fibrosarcome primitif de la fosse nasale droite. *Revue mens. de laryngol.*, 1886, No. 8.

72. Prof. DUBREUIL, Montpellier. Polype naso-pharyngien. *Gaz. médicale de Paris*, 1886, No. 45.

55. In order to facilitate the nasal examination from in front, and to fix its results more easily, BABER gives drawings of the conditions found, of which five are found in the publication in question. BABER believes that a much better conception of the condition found in anterior rhinoscopy is given by the drawings in connection with remarks, than by an extensive description.

H.

56. HEDINGER in his lecture discusses mainly the catarrhal diseases in the nasal cavity, with their complications. In acute

coryza, in himself or in others, he did not observe any effect from cocaine. In the first stage of chronic catarrh, especially with extensive dryness of the nose, insufflation of nitrate of silver in very small doses has proved extremely valuable. In considerable swellings of the nasal mucous membrane chromic acid or the galvano-cautery are employed—the former in slight, non-inveterate cases, the latter in large hypertrophies, polypoid degeneration, or swelling of the turbinated bodies. In the second half of his lecture HEDINGER discusses the reflex neuroses and accepts HACK's standpoint with regard to the most important points.

H.

57. ANTONELLI reports a case of ulcerative rhinitis, resisting other remedies, cured by the application of a sublimate salve (0.01 by 10.0 vaseline) within a short time. S.

58. Three cases of anosmia in syphilitic patients. The author supposes two to be produced by intracranial lesions; in the third ulcerations and necrosis were present in the nose. V. BREMER.

59. KRIEG, in reference to the etiology, distinguishes the deviations of the nasal partition produced by elongation from those by luxation. The causes given are unequal growth of the bones, sleeping on one side, and injuries. Among the consequences of scoliosis the author mentions, besides the usual consecutive appearance, an empyema of the antrum Highmori, observed three times in himself on the narrowed side. He supposes that reflex troubles may probably be caused by the deviation. Krieg considers partial resection the best procedure for the treatment of the deviations. H.

60. WOLTERING, by means of a cutting bone-forceps devised by him, removed a shell of bone which, originating from the septum at the proc. palatinus of the upper jaw and the lower margin of the vomer, filled up the whole half of the nose. S.

61. SCHMIEGELOW describes the reflex neuroses of the nose and the throat elaborately and with careful reference to the literature. Among his observations the spasms are the most frequent. Bronchial asthma—principally with nasal polypi, 9 times among 40 cases,—cough, sneezing attacks, and laryngeal spasms. Among the sensory neuroses those found in the region of the fifth nerve are especially mentioned; among the vasomotor ones erythema of the nose and the cheeks. V. BREMER.

62. ZIEM, after trying to define precisely the causes of the concomitant neuralgias in nasal and pharyngeal diseases, opposes

the view that these might originate from the uninjured mucous membrane itself. The neuralgias are due, he believes, to ulcerative processes of the mucous membrane laying bare nerve fibres, or, more frequently, to an affection or an occlusion of the accessory cavities, especially of the frontal cavities, by means of the swelling of the nasal mucous membrane. Hence the necessity of stating in these cases whether the frontal cavities are free or not. The pressure in the vertex, which is often felt in chronic nasal obstruction, may be effected by the closure of the cranio-nasal emissary vessel, in consequence of which the proximate parietal emissary, which is situated backwards, becomes congested. This may also be the result of a diminution of conductivity in the nasal lymph paths, which serve as an outlet for the cerebro-spinal fluid.

S.

63. The observation that a vehement convulsive attack could be produced by touching the epiglottis of an hysterical patient, induced LICHTWITZ to make further investigations. In six other hysterical patients, besides other zones, some were also found in the nose, from which convulsions could be produced. They were bilateral five times; unilateral once. In two cases cocaineization produced abolition of the irritability. Lethargic and hypnotic zones may exist in addition to "spasmogenetic" ones. "Hysterogenetic zones" were found in the nose, mouth, pharynx, and larynx. Lichtwitz points to the fact, that these "hysterogenous zones" must be known, in order to be prepared for unpleasant accidents in operations.

H.

64. In the surgical section of the meeting of naturalists in Berlin, VOLTOLINI demonstrated electrolytic forceps and pincettes and a new electrolytic cutting-loop, devised by him, for the removal of fibrous and fibro-sarcomatous tumors of the nasopharyngeal cavity, also explaining the advantages of electrolysis.

S.

65. GELLÉ attacks the general opinion, that death ensues after a posterior nasal tamponade in consequence of cerebral apoplexy, pointing to the fact that the consecutive acute inflammation of the middle ear may be the cause of the fatal issue in a number of cases. Gellé reports the case of a man, 55 years of age, in whom the posterior nares had to be plugged on account of severe epistaxis; the plug remained for 48 hours. Three days after its removal, vehement acute bilateral otitis media developed with perforation of the membrana tympani. Cure in three weeks.

The inflammation is produced by irritation of the middle ear by the putrid fluid caused by the plugging. Gellé and his colleagues taking part in the discussion on this lecture are apparently not familiar with the *Reviewer's* account of the dangers of the posterior plugging and its substitution by local arrest of the bleeding (vol. x. of these ARCHIVES). H.

66. Three cases of defect of the nasal partition, one of which is considered a congenital arrest of development, the other is mentioned as "traumatic perichondritis." In none of the three could syphilis be detected. V. BREMER.

67. BOVILL found in a Hindoo, 40 years old, a rhinolith, which had to be crushed with the bone-forceps before its removal became possible. The removed pieces weighed 160 grs. Before the removal there existed, besides obstruction and suppuration, swelling of the whole half of the face and facial paralysis. H.

68. CHATELLIER relates fully the microscopical examination of two mulberry-like hypertrophies of the posterior extremities of the lower turbinated bodies. He sums up the result of the examination as follows: that the growths consist of adenoid and mucous tissue, the one preponderating at one place, the other at another. The author appears to have considered the condition as one of myxomatous degeneration of the mucous membrane.

69. CHATELLIER found the same changes in the hypertrophies taken from the central and anterior part of the lower turbinated body.

70. CLAVERIE gives in a paper, containing 61 pages, a general description of the history, pathology, etiology, frequency, symptomatology, diagnosis, prognosis, and treatment of the primary malignant tumors of the nasal cavity. H.

71. MOURE's patient, a woman 43 years of age, had suffered for seven months when first seen, with frequently returning epistaxes. The examination revealed a red tumor of the size of a cherry-stone upon the anterior extremity of the middle turbinated body, which bled even when slightly touched with a probe or with a cotton plug. Operation was refused. The tumor grew in the course of a year so rapidly that the nose was completely obstructed, the other nasal cavity being closed by the dislodged septum. One year and a half after the first appearance the operation was performed. As a galvano-caustic loop could not be applied around the tumor, the nasal cavity was laid bare by an incision, running from the inner canthus downwards. The tumor

was successfully removed by means of the forceps and the sharp spoon. The operation was facilitated by Moure's knowledge, from the former examination, of the point of origin, which was then scraped out with the curette and sharp spoon, whereupon the bleeding soon stopped. Seven months after the operation no relapse whatever had occurred. The microscopical examination revealed a fibro-sarcoma. H.

72. DUBREUIL removed with Maisonneuve's loop a nasopharyngeal polypus (fibroma) springing from the base of the pterygoid process, without any bleeding whatever. S.

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## REVIEW.

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**Photographic Illustrations of the Anatomy of the Human Ear.** By B. Alex. RANDALL and HENRY LEE MORSE. P. Blakiston, Son, & Co., Philadelphia. 1887. Price \$5.

This very valuable work consists of 25 plates with 75 photographic illustrations mounted on pasteboard, very convenient to handle and pass round in a lecture room. The most important parts of the normal anatomy of the ear and a few pathological conditions of the drum-membrane and ossicles are illustrated. The bony parts occupy 14 plates, the drum-membrane 4, and microscopical sections of the external, middle, and inner ear 7. The work is a worthy counterpart of the celebrated photographic atlas of Rüdinger. It was with great pleasure that we have examined the photographs, compared many of them with corresponding specimens, and read the 18 pages of explanatory text. We can heartily recommend the collection to our readers. It will be a very agreeable repetition for the expert, and a great aid to teachers and students. H. KNAPP.

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## MISCELLANEOUS NOTE.

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Our esteemed collaborator, Dr. H. STEINBRÜGGE of Giessen, has been appointed extraordinary professor.

## ARCHIVES OF OTOTOLOGY.

### ON THE POSSIBILITY OF DETERMINING SOME IMPORTANT TOPOGRAPHICAL RELATIONS IN THE TEMPORAL BONE FROM THE FORM OF THE SKULL.

BY DR. OTTO KOERNER, FRANKFORT-ON-THE-MAIN.

Translated by J. A. SPALDING, M.D., Portland, Maine.

(With plate II.)

SOON after Schwartze's introductory papers on the mastoid antrum and its operative opening, Hartmann<sup>1</sup> and Bezold<sup>2</sup> minutely examined the anatomy of the entire region, and gave us new information concerning the so-called "dangerous" temporal bones. And by this phrase we mean those temporal bones in which the sigmoid fossa of the transverse sinus protrudes so far forward into the base of the pyramid and mastoid process, and in which at the same time the floor of the middle cranial fossa lies so low that the antrum cannot be opened without endangering the dura mater of the cerebral lobe and the transverse sinus.

Amongst the many authors who have referred to these dangers, Politzer<sup>3</sup> speaks in the most decided fashion :

"Another point which we have to consider before performing the operation, is the impossibility of deciding in any patient whether the mastoid process is pneumatic, diploetic, or solid, and whether in the given case the base of the skull or sigmoid fossa are anomalous or not. These things we can only learn as the operation proceeds, and this

<sup>1</sup> Langenbeck's *Archiv*, Band xxi.; and *Bericht ueber den 3ten internat. Otologen-Congress*, Basel, 1885.

<sup>2</sup> *Monats. f. Ohrenhklde.*, Band vii., No. 2, and Band viii., Nos. 1 and 2.

<sup>3</sup> *Lehrbuch*, p. 641.

is why we can so rarely decide beforehand whether the operation will or will not be successful."

This also is one of the reasons why so many different methods of performing the operation are from time to time suggested.

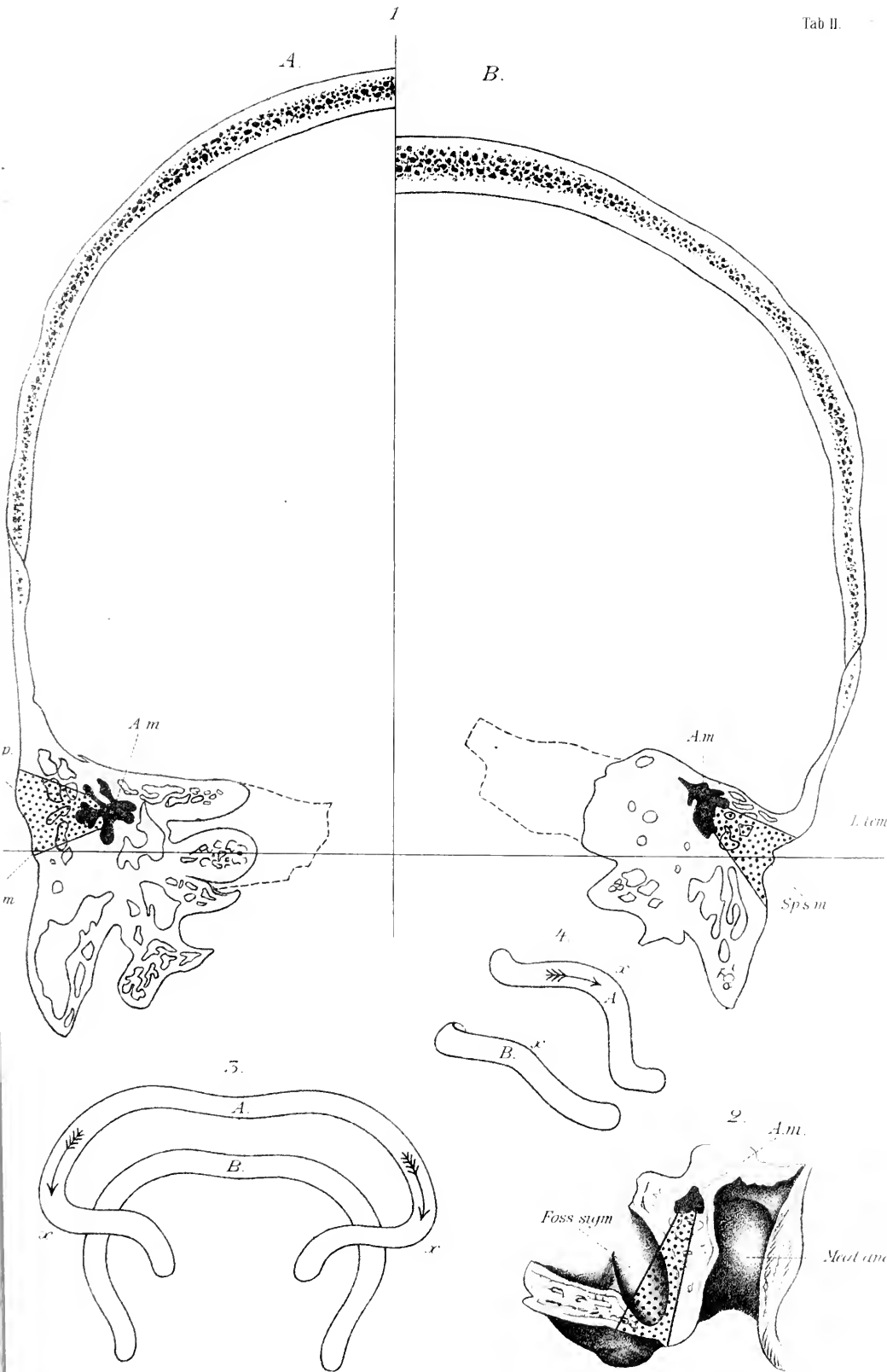
Thus, Hartmann says that we should invariably begin the opening as if we were sure of finding a "dangerous" temporal bone, whilst Schwartze brushes aside so strict a formula, and suggests (perhaps in reference to Hartmann's and Bezold's opinions) that the dangers of the field of operation have been greatly exaggerated.

In the midst of such confusion, therefore, we are urged to ask the important question: *Is there then no way in which we can foretell whether any given temporal bone is or is not likely to be a dangerous one?*

An off-hand comparison (without any measurements) of dolichocephalous and brachycephalous skulls shows that in the former the lateral walls are almost perpendicular to the base (Fig. 1, A), so that the distance between the outside of the mastoid processes is about the same as that between the parietal tuberosities, whilst in the brachycephalous skull the mastoid processes are not so far apart as the parietal protuberances, for the very simple reason that here the lateral walls converge from above downward (Fig. 1, B). The angle formed by the upper side of the pyramid and the squamous portion of the temporal bone resp. the lateral wall of the skull is in each case nearly a right angle. From this we see, then, that this side of the pyramid is almost horizontal in dolichocephalous skulls, whilst in the other variety of skulls it ascends sharply from without inward. And, finally, the inner and outer districts of the floor of the middle cranial fossa are about on the same level in dolichocephalous skulls, whilst in the brachycephalous skull the outer portion of the fossa is much deeper.

These variations in the topography of the temporal bone were so plain that I was led to investigate the question: *whether the exact situation of the floor of the middle cranial fossa and the course of the transverse sinus in the temporal bone in any way depended upon the form of the skull.*







My examinations were made on one hundred and twenty temporal bones from the skulls of thirty-eight different races, and twenty-two that were exclusively German, all sawn through the sagittal median plane.

Particular attention was given to skulls of different races in order that all variations might be compared, and the laws of formation, if any such existed, might the more easily be discovered. As was to have been foreseen, the rules discovered in these skulls were also available in those of German origin.

The investigations that I have lately made have convinced me that various measurements easy to be obtained give us such sufficient information in regard to the form of the skull as to enable us to decide upon important anatomical relations in and about the temporal bone. If we measure with calipers the distance between the bridge of the nose and the most prominent point of the occiput (which, by the way, does not always correspond to the external occipital protuberance), and then the distance between the parietal protuberances, and, finally, if we divide the last measurement into the first, we obtain a number, which, for the sake of brevity, I will call the index. This index varies in my collection of skulls between 1.55 (dolichocephalous) and 1.07 (brachycephalous). The slight variations which arise in the living, from including the thickness of the scalp in the measurements, may safely be neglected. The only occasional difficulty during the measurements is that the parietal protuberances are absent in pronounced dolichocephalous skulls, so that really the most prominent points of the lateral walls are no further apart than the mastoid processes. How then in such cases shall we measure the breadth of the skull? The superior and posterior angle of the origin of the temporal muscle should be regarded as the same as the parietal protuberances. In bare skulls we should start from the linea semi-circularis, which forms the above-mentioned limit of the temporal muscle, whilst in the living we can easily feel the expansion of the muscle by causing the patient to execute the motions of chewing.

I will now append the indices of the various skulls :

Index.	No.	Race.	Index.	No.	Race.
I.55	1	Shangalla negro.	I.29	3	Chinese, Russian, German.
I.52	2	Ashantee, Australian.	I.27	1	Chinese.
I.49	1	Gaika-Kaffir.	I.26	2	German, Russian.
I.45	1	Negro.	I.25	3	Russian, 2 German.
I.44	3	Negroes.	I.24	4	2 Russian, 2 German.
I.43	1	Australian.	I.23	1	German.
I.42	1	Ashantee.	I.22	2	Russian, German.
I.41	1	New Caledonian.	I.21	1	Russian.
I.40	3	Ethiopian, Australian. Greenlander.	I.20	2	Javanese, German.
I.39	1	German.	I.18	1	Russian.
I.37	2	German, Ashantee.	I.17	3	Javanese, German, Russian.
I.34	4	Chinese, Papua, 2 Australian.	I.16	2	Peruvian, German.
I.33	1	Anamite.	I.15	1	German.
I.32	4	2 German, Russian, Chinese.	I.13	1	
I.31	3	2 German, Chinese.	I.12	1	
			I.07	1	Goway-Indian.

In order to compare the varying situation of the floor of the middle cranial fossa and the transverse sinus, we must invariably refer to unalterable points upon the skull. And these points are:

(1) *The most anterior portion of the linea temporalis*, which is, however, not very serviceable on account of its many variations.

(2) *The upper end of the porus acusticus externus*; and

(3) *The spina supra meatum*, which is a small bony prominence at the posterior and superior margin of the porus, the end of a small ridge which splits off from the linea temporalis above the external meatus, and stretches off in the rear. The spina is rarely absent, but it varies in form, sometimes being a point, sometimes a notch, or occasionally a small bony comb. Its position is also occasionally occupied by a little pit, which, nevertheless, is of as much aid in orientation as the spina itself.

If, now, we wish to draw from these external marks any conclusions in regard to the floor of the middle cranial fossa, we must first establish the location of the boundary line between the floor itself and the lateral wall of the fossa; and this can be done with the aid of the ortho-pantograph, or with a pair of caliber compasses.

The results of my measurements in this respect are contained in the following table *in millimetres*:

Index of Skull.		1.55—1.40	1.39—1.30	1.29—1.20	1.19—1.07
The floor of the middle cranial fossa lies above the porus acust. externus.	average .	11.5	5.8	5.1	4.8
	highest .	17.	15.	9.	7.
	lowest .	7.	4.	2.	2.
The floor of the middle cranial fossa lies above the spina supra meatum.	average .	15.3	12.1	7.6	5.8
	highest .	17.	17.	12.	9.
	lowest .	10.	7.	5.	4.

*The table shows us that the floor of the middle cranial fossa in dolichocephalous skulls lies higher above the porus acusticus externus and the spina supra meatum than in brachycephalous skulls.*

If, then, we know the index of any given skull, the table will assist us greatly in determining the location of the floor of the middle cranial fossa.

It is also well worth observing that the average measurements, as well as the maxima and minima, are all greater with higher indices than with the lower.

The application of all these facts in operations upon patients is hindered by the concealed position of the external starting-points. We can, indeed, easily discover with the sound or the tip of the little finger the upper edge of the porus from the meatus externus, but in order to reach the spina supra meatum, we must freely loosen the auricle from its attachments and bend it forward. The following method may also prove of some assistance: If we imagine a straight line projected through the outer and lower angle of the bony orbit and the upper margin of the porus, the floor of the middle cranial fossa, at least in the mastoid region, will be found to lie as high above this line as above the porus itself.

If we have a well-pronounced dolichocephalous skull, the linea temporalis may, under certain circumstances, pass through the field of operation (Fig. 1, A). In such a case we should utilize the space above, as much as possible, in order to obtain a large orifice for the operation, and a good view into the bottom of the cavity.

The operation is much more difficult in well-marked brachycephalous skulls, because when the petrous bone rises higher as we proceed inward, and the middle cranial fossa is deep, we are sure to find that the antrum, too, lies high (Fig. 1, B). We must therefore chisel obliquely, because the summit of our excavation ought not to lie any higher than the upper part of its external margin.

*All that we have so far shown goes to prove that it is desirable in every operation on the mastoid process to begin as far forward as possible.*

After we have learned how to avoid the middle cranial fossa, the "dangerous" temporal bone offers a new risk; the *transverse sinus* occasionally advances so far forward and outward into the mastoid process that it may in some cases absolutely prohibit the operation (Fig. 2). But we cannot precisely state the frequency of these cases, because the danger of the sinus is a relative idea. A skilful operator may proceed without risk, where the unskilful one will open the sinus. I have in one hundred and twenty temporal bones found but three in two skulls in which it would have been impossible to avoid injuring the sinus.

The more or less dangerous sinus is rarely seen, except with a deep middle cranial fossa, *i. e.*, in brachycephalous skulls. Bezold observed the same coincidence; and for this reason I have endeavored to ascertain to what extent the danger of the transverse sinus depends upon the form of the skull.

Index.	1.55—1.50	1.49—1.40	1.39—1.30	1.29—1.20	1.19—1.07
Right {					
average . .	7.83	8.22	6.00	5.05	4.22
maximum .	9.00	15.00	14.00	7.50	5.50
minimum .	7.00	4.00	3.00	2.00	2.30
Left {					
average . .	10.00	9.72	7.86	7.34	5.50
maximum .	11.00	12.00	15.00	11.00	8.50
minimum .	9.00	7.00	5.50	1.75	3.00
Average difference between right and left in favor of					
left . . . . .	2.17	1.50	1.86	2.29	1.28
Total average for both sides . . .	8.91	8.97	6.93	6.19	4.86

*My measurements show that the sinus lies farther outward in brachycephalous skulls than in the dolichocephalous, and that (independent of the form of the skull) it lies farther outward on the RIGHT side than on the LEFT.*

The table shows in *mm* the thickness of the bony wall of the sulcus transversus at its thinnest spot within the mastoid region.

The walls were equally thick on both sides in 10 %, thicker on the right side in 77 %, and thicker on the left side in 13 %.

All of the skulls apparently confirmed the assertions of Hartmann and Bezold, that the deeper the sinus penetrates into the mastoid, the further in front it lies.

In regard now to the influence of the form of the skull upon the "danger" of the transverse sinus, we can certainly affirm that in the brachycephalous skull the sinus on both sides extends farther forward and outward into the mastoid process than in the dolichocephalous. But we must expressly emphasize that the "danger" is not proportional to the degree of brachycephalicity, because the two skulls that I observed with the most dangerous transverse sinuses had indices of but 1.22 and 1.26 respectively; or in other words, they were distinctly but not extremely brachycephalic.

I would therefore propose the following rule for avoiding the sinus in operations on the mastoid process:

*The smaller the index the farther forward the opening should be made; if the patient is an adult, with an index of 1.30 or less, we ought to operate, if possible, in front of the auricular attachment, particularly if the right antrum is the one involved.*

I have so far spoken only of the dangerous situation of the sinus in adults, for this condition is not found in the immature, but is only first observed during the growth of the skull. The average distance of the sigmoid fossa of the sinus from the meatus is in young children not only relatively, but absolutely, greater than in adults (Hartmann).

With the form of the skull, however, there is this difference, that it is congenital, as has been satisfactorily and

finally determined by Lucae's measurements, extending over long series of years.<sup>1</sup>

We are therefore next inclined to ask what it is during the growth of the skull that makes this sinus in the brachycephalous more dangerous than in the dolichocephalous.

Bezold and Ruedinger suspect that the greater supply of blood to the right sinus forces it deeper into the mastoid process. For, as they say, the great horizontal blood-vessel of the dura does not generally divide at the torcula herophili into a right and left sinus, but it continues on as the right sinus, whilst the left sinus receives the lesser blood supply of the vena magna Galeni. *Under these circumstances, then, it would really seem as if the pressure of the blood current against the curves of the sinus would, during the growth of the bone, burrow for itself the deepest bed at that spot against which it was propelled with the greatest force.*

According to this idea the blood current in the brachycephalous sinus ought to press more forcibly forward and outward against the mastoid than in the dolichocephalous, because the posterior cranial fossa in brachycephalous skulls being broad and narrow, the sinus alongside will be more sharply curved than in the longer and narrower fossa of the dolichocephalous skull. A glance at Figs. 3 and 4 exhibits this suggestion to perfection. A is the brachycephalous sinus; B, the dolichocephalous; seen in Figure 3 from above, in Fig. 4 from one side. In both cases, *x* is the curve pressing against the base of the pyramid.

In conclusion, I hope that all who have the proper material at hand will investigate and verify my assertions.

#### *Explanation of the Figures.*

FIG. 1.—A, frontal section of a dolichocephalous skull with index of 1.42; B, frontal section through the right half of a brachycephalous skull with an index of 1.15.

Both sections are set alongside of one another, so as to compare the situation of both temporal bones.

Sections are made through spina supra meatum. The antrum is black; the portion to be chiselled out is dotted.

<sup>1</sup> *Festschrift fuer die 13te Vers. der deutschen anthrop. Ges.*, Frankfurt a. M., 1882



A. m.—Antrum mastoideum.

L. temp.—Linea temporalis.

Sp. s. m.—Spina supra meatum.

FIG. 2.—Horizontal section through a mastoid process with “dangerous” location of the sinus. From Politzer. Lettering as in Fig. 1.

FIGS. 3 and 4.—Paraffine cast of the transverse sinus of a brachycephalous (A) and of a dolichocephalous (B) skull one half natural size. The casts are obtained in the following manner: A delicate rubber tube with walls 5 *mm* thick is carefully laid into the sulcus transversus and firmly affixed with strips of adhesive plaster. The cavity is next filled with melted paraffine under high pressure. After this has cooled, the skull, after repeated sawing, is torn asunder. The casts thus obtained are drawn with the ortho-pantograph, and reduced to one half of the natural size.

## NEGLECT OF TREATING THE NASO-PHARYNX A CAUSE OF FAILURE IN THE MANAGEMENT OF CHRONIC SUPPURATION OF THE EAR.

BY WILLIAM A. DAYTON, M.D, NEW YORK CITY.

**A**URAL literature abounds in the relationships between naso-pharyngeal inflammation and "catarrh" of the middle ear, while little or nothing has been advanced with reference to diseases of the upper air-passages in connection with the treatment of suppurative otitis media.

There may be, of course, writings upon the subject with which I am unfamiliar; but I have yet to have a patient with suppurating ears tell me, when questioned as to previous treatment, that naso-pharyngeal inspection, medication, or surgical interference has formed any part of the care given them; and these observations have been made, largely, in the three aural clinics with which I am connected.

A brief report of three cases will save needless detail:

Nov. 13, 1885, John K. P., æt. twenty-one. History of ch. supp. left tymp. after bathing; of about ten years' standing. Constant, offensive discharge; uses syringe daily. Has had all sorts of applications made to his ear; has snuffed salt water into his nostrils and used gargles. Large circular perforation in anterior, inferior quadrant. Hearing for the watch, after douching ear and inflation, =  $\frac{5}{40}$ . Patient is a "mouth-breather." Left nostril almost occluded by deflected septum. Marked enlargement at extremity of both turbinated bodies. Smokes cigarettes, which fact the appearance of the whole surface of the pharynx betrays.

*Treatment.*—Cartilaginous septum straightened by crucial incision and plugs ; subsequent removal of the hypertrophied membrane at ends of turbinated bones by Jarvis snare ; pharynx treated by appropriate astringents ; and the ear kept clean by requisite applications of hydrogen peroxide and inflations. On two or three occasions, during the time he was under observation, I introduced, through a catheter, a few drops of a ten-grain solution of nitrate of silver to the left Eustachian tube. Patient ceased to visit my office Dec. 3d. Came again Jan. 3d. The discharge had then ceased. He said he could not remember the day when his ear stopped running. Thought it was about three weeks ago. Membrane was covered by an incrustation, which I did not disturb, as the hearing was  $\frac{8}{40}$ . He promised to let me know if discharge ever recurred, and he has not returned.

Carrie W., æt. eleven. History of chronic suppuration both middle ears since early dentition. Treated at various dispensaries for years. Has “had lots of polypuses cut out of her ears” ; used a syringe several times a day, and never had her nose examined. When first seen at the Harlem Dispensary (in August, 1884), the meatuses were full of viscid, discolored, offensive pus, mixed with a powder (boric acid ?) that had been prescribed for her. The depth of both canals, after cleansing, presented masses of granulation tissue. I neglected to make the watch test until I saw her the third or fourth time ; but she was very hard of hearing for the voice. I do not believe she could have heard the tick of any watch. Patient was a “mouth-breather.” Her tonsils were hypertrophied ; the vault of the pharynx was filled with pendulous “vegetations” ; and the mucous lining over the middle and inferior turbinate bodies was thickened and swollen. The septum was but slightly irregular.

*Treatment.*—The tympanic cavities were cautiously scraped, under cocaine, with a Buck’s curette.

Both membranes were found to be destroyed, but the ossicles, except the manubria, were intact. Peroxide of hydrogen was used as a cleanser, etc. ; Valsalva’s experiment performed ; and strong nitric acid applied.

At the same sitting the vault of the pharynx was scraped with a curette, which I devised and described in the *Medical Record* of Dec. 12, 1885 ; and the following directions were given : a weak solution of bicarbonate of soda, warmed, to be snuffed into the nostrils thrice daily, followed by the insufflation of this ointment :

R̄—Iodoformi	.	.	.	.	.	gr. iv.
Natr. biborat.	.	.	.	.	.	℥ i.
Ol. gaulth.	.	.	.	.	.	℥ iii.
Petrolati	.	.	.	.	.	℥ iv.

SIG.—Use after cleansing.

The ears to be kept clean and dry by the use of hydrogen, peroxide, and absorbent cotton, and the practice of Valsalva's inflation. At the next sitting I excised a small portion of the right tonsil, and under the influence of iodine alone the opposite gland gradually shrunk. Astringents were applied to the pharyngeal vault and nares. Progress was manifest from the start. It was more than three months before the drum-heads cicatrized, but during that time there was no offensive discharge; the granulations returned only once, and the hearing was, with the aid of Toynbee's artificial membrana tympani, R. E. =  $\frac{3}{40}$ ; L. E. =  $\frac{5}{40}$ .

Two sisters, aged respectively eight and a half and four years, previously inmates of an orphan asylum, were sent to my clinic at the Post-Graduate School early in February, 1886. Maggie, the elder, had a bilateral suppuration of over five years' duration, the result of scarlatina. The younger one's (Nellie's) left ear had been suppurating for more than two years, and the cause was traced to mumps. Ears presented the familiar appearance of neglect, although treated for a long time by syringing, ear drops and powders. The nasal douche had been recommended and employed. The hearing distance by means of the watch could not be accurately determined; but both children heard ordinary conversation poorly. It was impossible to secure good rhinoscopic images in these cases, but the children were typical "mouth-breathers." The nostrils were almost collapsed, the tonsils were hypertrophic, and, inserting my finger behind the velum, I found the post-nasal space well filled with adenoid vegetations.

*Treatment.*—Vault scraped with my curette and afterwards with finger-nail. Projecting tips of tonsils snipped off with scissors, and subsequently painted with tincture of iodine. Nostrils dilated with cotton plugs, smeared with an ointment of tannin and vaseline. The suppurating ears were kept clean with hydrogen peroxide and a four-per-cent. solution of arg. nit. applied to the exposed tympanum, after drying and inflation. At the expiration of two weeks, the guardian of these children wanted to know "if it was necessary to come any more." There was little or no discharge from the ears, and the improvement in hearing was mar-

vellous ; the only thing, really, that remained to be done was to correct *the habit* of mouth-breathing. This was finally overcome by breathing exercises.

A favorite method with me is this : I teach the patient to take a deep, rapid inspiration through the nostrils, in three seconds, with the lips tightly closed ; then, without opening the mouth, prolong the expiration from ten to fifteen seconds. When practised five or six times daily, and continued for several minutes, I find that this does away very materially with shallow, mouth-breathing. So long, however, as the upper air passages are obstructed in any way, this cannot be well accomplished. *Inspiration through the mouth, under any circumstances, is abnormal ;* and the writer is certain that the inclination to mouth-breathing in consumptives is a leading cause of their well-known refractory aural suppurations.

These few cases illustrate sufficiently the salient points in a large class of aural patients, who do not have adequate management. It is to be feared that the process of repair in an exposed tympanum is, in the tedious and frequently empirical methods of treatment, often forgotten. Cleanliness, to maintain good drainage and to prevent decomposition, is indispensable ; but the mere checking of a purulent discharge is not a sufficient aim. What otologist has not, at some time, had this statement flung at him : "Yes, you have stopped the discharge, but you have made me deaf." Again, the possible danger to the mastoid cells should not be overlooked in our efforts to arrest secretion in the tympanum.

Another great stride will be made in our specialty, when all otologists become expert with the rhinoscopic mirror.

The treatment of naso-pharyngeal disease in connection with medication of the tympanum in chronic suppuration, will, on the whole, give very satisfactory results, while to neglect such treatment is to leave a large class practically unbenefited.

# THE RELATIVE FREQUENCY OF EAR DISEASES IN THE WHITE AND COLORED RACES IN THE UNITED STATES.

By SWAN M. BURNETT, M.D.,

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IN the volume of the *Archives of Ophthalmology* for 1884 I published some statistics showing the comparative frequency of eye diseases among the white and colored races as found in my clinical service at the Central Dispensary. As these figures showed that race exercised a very marked influence on the prevalence of certain eye affections, it was considered a legitimate subject of inquiry as to how far race affected the relative frequency of ear diseases in our mixed population.

I am enabled now to present some statistics bearing on this point, collected from the same source. The numbers, it is true, are small, but they are quite sufficient, I believe, to show that there exists a very considerable difference in the liability of the two races to certain forms of ear disease. I append a tabulated statement prepared by my assistant, Dr. T. A. Taylor.

It will be observed, in the first place, that of the 373 cases 189 were white and 184 colored—that is to say, they were equally divided. In the eye clinic of the same institution the diseases were nearly twice as frequent among the negroes as among the whites (2,426 colored to 1,324 white).

The negro, then, is not subject as a race to ear diseases as frequently as the white man. It has been generally accepted, I believe, by all those who combine the practice of

Diseases.	White.	Colored.
Eczema of auricle . . . . .	6	10
Furuncle of meatus . . . . .	4	3
Impacted cerumen . . . . .	12	15
Otitis externa . . . . .	2	4
Occlusion of external meatus . . . . .	1	
"    "    "    "    partial . . . . .	1	
Polypus . . . . .	2	2
Otitis catarrhalis, acute . . . . .	19	34
"    "    subacute . . . . .	4	6
"    "    chronic . . . . .	20	23
"    purul., acute . . . . .	14	5
"    "    chronic . . . . .	55	52
Sclerosis (dry catarrh) . . . . .	38	9
Mastoiditis . . . . .		1
Nervous deafness . . . . .	5	4
Deafness following pertussis . . . . .	1	1
Tinnitus aurium . . . . .	2	1
Otalgia . . . . .	2	2
Sebaceous cyst of auricle . . . . .	1	1
Tumor of lobule . . . . .		13
Total . . . . .	189	184
	373	

ophthalmology and otology that among the white race ear diseases form from twenty to twenty-five per cent. of the cases observed, and the law holds good as to the white portion of my clinical service. In the negroes, however, the ear diseases amount to only about ten per cent. of the whole number of eye and ear cases presenting for treatment. The actual figures of the number observed during the same time are as follows:

	White.	Colored.
Eye diseases . . . . .	788	1,512
Ear " . . . . .	189	184

In this connection it may be stated that there is a legend to the effect that there is little or no deafness among the North American Indians. How far this is true I have never been able to determine from personal observation, but from inquiries of army surgeons and others who have lived among them I am satisfied that, at any rate, ear disease is not a necessary consequence of savagery or barbarism. On the other hand, eye diseases are, I learn, very common among the Indians, cataract being a frequent cause of blindness.

Coming down now to particular affections, it will be seen that while they are apparently more prone to the acute catarrhal diseases, and are quite as frequently affected with chronic purulent otitis media, *the negroes rarely suffer from dry catarrh*, which is the cause of so much of the incurable deafness in the white race. Those who do suffer from this malady have it in a mild form, and never, according to my observation, attain to that amount of deafness which renders ordinarily loud conversation difficult to understand.

*Inspissation of the cerumen* seems to affect both races in about the same proportion. It has been noticed by several observers that the negro girls are more often affected with *tumors of the lobules* than their white sisters. Whether this comes from the greater frequency of the practice of piercing the ears and wearing ear-rings among them than among the whites, or whether there is some race-predisposition to the formation of these tumors, it is difficult to tell, but probably both are factors in the production of larger percentage of the tumors in the negroes.

Since these statistics were collected and were being arranged for publication, Dr. T. E. Murrell, of Little Rock, Arkansas, read a paper on the same subject before the otological section of the International Medical Congress. I did not have the pleasure of hearing this paper read, and therefore do not know what his exact figures are, but I have read the abstract which he furnished for the programme of the meeting, and find that his general conclusions differ in some points of detail from mine. We are agreed as to the less frequency in general of ear diseases in the negro, but while he finds that chronic otitis media suppurativa is not often met with, my statistics show about an equal distribution of the affection in the two races. On the contrary, he does not seem to have noted the very great difference in the occurrence of dry catarrh as the statistics here presented show. It is to be hoped that others who have the opportunity of observing ear diseases in the two races together may be led to report the results of their observations.



## NECROSIS OF THE LABYRINTH AND PARALYSIS OF THE FACIAL NERVE.

BY DR. FRIEDRICH BEZOLD, MUNICH.

Translated, somewhat abridged, by Dr. H. A. B. MACCAULEY, New York.

(*With a heliotype plate.*)

TOYNBEE, in 1864, in the first volume of the *Archiv für Ohrenh.*, directed universal attention to the relatively not infrequent occurrence of partial or total necrosis of the labyrinth, and since then the number of observations, especially of exfoliation in the living subject, has increased to about forty-five.

The inflammatory process in the middle and internal ears, which leads to this exfoliation, is not only prejudicial to the ear itself and the neighboring organs, especially the distribution of the facial nerve in the temporal bone, but the accompanying suppuration, which may continue months or years, is extremely dangerous. Bearing in mind the relative infrequency of necrosis of the labyrinth, I take the liberty of presenting the following five cases, which have come under my own observation during the last three years :

CASE I.—*Necrosis of a turn of the cochlea, or of a semi-circular canal, with temporary facial paralysis.*

Mr. J. K., 28 years old. R. otorrhœa since youth ; same condition existed formerly on left side also. *March*, 1883.—Noticed sudden aggravation of symptoms on right side, with vertigo, unsteadiness of gait ; right facial paralysis making its appearance at same time. The pain in head and ear was, at that time, very violent, but moderated after the removal of several polypi, and

the facial paralysis disappeared permanently. Present treatment consists of injections of a 1 % solution of carbolic acid.

June 8, 1883.—I examined patient for the first time, and found neither swelling nor mastoid tenderness. A growth about half the size of a pea was seen on the superior posterior wall of the osseous portion of the auditory canal. The probe discovered the same to be a fistulous opening, through the centre of which the probe passed about 1 cm in the direction of the mastoid antrum. The opening discharged upon this an opaque secretion, a large quantity of which was afterwards removed by a curved tube introduced in the same manner. No trace was found of the membrana tympani. As far as can be seen the wall of the tympanum is covered anteriorly and posteriorly with superficial polypous growths. Politzer's method unsuccessful.

Right ear deaf to low conversation and the watch, but tuning-fork is heard through the air. Placed upon the vertex the same is heard in the relatively normal left ear. The polypous growths upon the internal wall of tympanum removed by the snare.

Toward the end of July, 1883, a larger growth appeared at the fistulous opening, after the removal of which a still larger mass, together with a couple of fragments of bone, were brought away by the syringe. One of these was shaped like a crooked tube, and was unmistakably a piece of a semi-circular canal, or from the cochlea. Direct injection into the aditus ad antrum removed a small cholesteatomatous mass of a dirty-yellow appearance, containing epidermic scales, with crystals of cholesterine. I regret to say that the hearing was not tested after this.

A letter was received from the attending physician, December 19, 1885, reporting entire cessation of the suppuration.

*CASE II.—Necrosis of the lower turn of the cochlea, followed by subsequent facial paralysis.*

Mr. G. N., 41 years old. Seen Oct. 9, 1883, for the first time. Has heard badly with left ear since youth, and remembers to have had evil-smelling discharge from the same ear for the last fifteen years. Father was also hard of hearing and had a discharge from the ear.

Since April, 1883, has had continuous pain, becoming so violent at times as to cause insomnia and inability to work. Towards end of May the discharge became more copious and has remained so ever since. Vertigo and tinnitus aurium were not present. About



*Fig. I*



*Fig. II*



*Fig. III*



*Fig. IV*



a week ago a polypous growth was removed from the ear at Innsbruck, whereupon the pain increased. Paralysis of the left half of the face showed itself four days ago. Patient anæmic, with anxious expression of countenance, and gives impression of one very ill. Pressure on pars mastoidea seemed to give very little pain. A polypus, bleeding upon slight provocation, was seen in the external meatus, extending into the cartilaginous portion, and was removed at once with the snare.

*Hearing.*—Loud conversation (left) heard with closed as well as with the open ear. Right ear normal. Tuning-fork  $a^1$  not heard by diseased ear through the air. When placed on vertex patient could not tell in which ear he heard it.

*October 11th.*—Pain in the ear has ceased. Yesterday evening patient had headache and went to bed; slept pretty well, however, for the first time after many sleepless nights. A sound introduced to-day into the external auditory canal strikes rough, bare bone behind the remaining stump of the polypous growth, and gliding over the same passes down deeper.

*Oct. 13th.*—Stump of polypous growth trimmed down with the snare.

*Oct. 15th.*—Sequestrum appreciable to a greater extent behind the growth, but removal with the forceps is not feasible. Up to Oct. 30th the discharge was moderate, with absence of pain. The growth, which had enlarged again, was removed.

*Nov. 1st.*—The rapidly increasing growth again removed. Sequestrum now visible.

*Nov. 3d.*—Growth was again snared off, and the sequestrum was extracted with the forceps, it breaking into three small fragments as it was removed. Patient goes home.

*Nov. 25th.*—No discharge since extraction. Feels strong and able to work. Some secretion, together with epidermic flakes, removed by the syringe. A small polypus about size of lentil removed by the snare from posterior wall of the osseous portion of auditory canal. Auditory canal now wide and free from granulations. The space in the depths is bounded by a gray, irregularly shaped surface, which gives bony resistance on contact with the probe. The innermost part of the posterior superior wall of the osseous portion of auditory canal is lacking, and a probe introduced passes more than 1 cm in the direction of the antrum. Cubic contents, right (normal ear with normal hearing distance), 1.1 ccm; left, 1.8 ccm. Tuning-fork  $a^1$  on vertex is

heard in right ear from right mastoid, 10 seconds; on left mastoid process, 7 seconds. Rinne's experiment, right, + 32 seconds. Loud voice, with closed right ear, heard, left, at 6 cm; low conversation indistinctly understood, left, likewise with closed left ear. The facial paralysis persists unchanged.

Dec. 22, 1885.—Over two years after his illness patient reports return of health and strength. Ear has remained dry since treatment was discontinued. The complete facial paralysis noticed two years one and a half months ago, which was persistent at that time, the whole half of the face hanging down loosely, was to my great surprise no longer noticeable when the muscles were in repose. Galvanic and faradic irritability of the left facial nerve and distribution is not inconsiderably lessened. Intramuscular irritation shows a weaker contraction than on normal side, but of the same duration. There is, hence, simple diminution of electrical irritability without qualitative changes. This is probably the result of degeneration reaction.

*Sequestrum.*

(Heliotype plate, Fig. I., *a*, *b*, *c*, and *d*).

The three pieces into which the sequestrum broke consist of :

1. A large piece of the lower turn of the cochlea of distinctly characteristic form (Fig. I., *a* and *b*).
2. A small saucer-shaped piece, smooth and concave, likewise belonging to the cochlea (Fig. I., *c*), and
3. An irregularly notched fragment, whose exact relation to the cochlea could not be determined (Fig. I., *d*).

CASE III.—*Necrosis of the lower and middle turns of the cochlea with permanent facial paralysis.*

J. B., woodchopper, æt. forty-eight, seen by me March 9, 1885, for the first time. At age of seven was kicked by a horse on left side of head, and for three or four years had a discharge from the left ear and loss of hearing. The discharge then ceased and did not appear again until three months ago, and has continued since then; the patient giving as cause for the same his having taken a vapor bath for his rheumatism. With the re-appearance of the discharge complete left facial paralysis was noticed, which has persisted unchanged since then. Lately complains of violent pain in the left ear and sleepless nights. Discharge copious and fetid. Externally the pars mastoidea is apparently unchanged,

but gives pain on pressure on part corresponding to the mastoid antrum. The bottom of the auditory canal is filled by a mass consisting partly of thickened epidermis and partly of a red growth springing from posterior wall of the osseous portion of the auditory canal, this proving to be granulations surrounding the mouth of a fistulous opening. Politzer's method does not give perforation whistle.

The  $a^1$  tuning-fork not heard through the air. The growth increased rapidly, and was removed March 12th, and again on the 16th. Rough, bare bone is now felt in the depths of the canal with the probe.

Inflation produces a thin whistling sound. March 24th and 29th growths about size of a pea were removed by the snare. April 1st the modiolus which lay free in the auditory canal was removed with forceps, together with the first turn of the cochlea. The canal is still narrowed by granulations in its depths. Perforation whistle on inflation. No vertigo or subjective noises have been noticed during the course of the disease. Up to May 7th there was no discharge to amount to any thing, although the deeper parts were still covered with easily bleeding granulations.

*May 1st.*—Discharge has ceased entirely, and perforation whistle is no longer obtained.

*Jan. 14, 1886.*—Ten months after removal of sequestrum there has been no return of suppuration. Politzer's method gives a dry blowing sound.

*Hearing.*—Right membrana tympani shows a whitish opacity with absence of normal reflex. The handle of the malleus projects more than usual, and the posterior fold is indicated. Hearing distance for low voice 90 *cm*. Tuning-forks A, a,  $a^1$  on vertex. Patient claims to hear them in left ear with closed as well as open right ear. With the fork on the right processus mastoideus he locates the tone in the left ear. Tested later on, however, he hears it in the right ear. The deeper tuning-forks A, a,  $a^1$  were not heard through the air with the left ear.  $a^{11}$ ,  $c^{1111}$ , and  $c^{1111}$  sharp were, however, heard with right ear firmly closed with the finger. With closed right ear low voice is not understood by left ear. The loud voice is heard about 12 to 15 *cm*, left, quite as well when the ear is closed. The patient was examined on same day for disturbances of equilibrium—with eyes open patient walks rapidly and turns with perfect facility—with bandaged eyes, however, some uncertainty of gait is noticeable. The facial paralysis

remains complete as before. When the right eye is closed, the left remains wide open. Perception of taste is lost for sweet, bitter, sour, etc., in anterior portion of left half of the tongue.

Examination of N. facialis showed complete degeneration reaction, the nerve giving no response to either galvanic or faradic current. The muscles gave no response to the faradic, but contract weakly with galvanic current (without reversion of the contraction formula). The sensibility of the muscles to the galvanic current is partially diminished, corresponding to the late stage of the paralysis.

*Sequestrum.*

(Heliotype Plate, Fig. II., *a* and *b*.)

The sequestrum removed consists of the base of the modiolus and the parts of lower and middle turns of the cochlea which are adjacent to it; also that part of the beginning of the lower turn running straight towards the fenestra rotunda. From within the fundus of the porus acust. int. (Fig. II., *b*), with the central part of the tractus spiralis foraminulentus, appears distinctly visible. This part of the sequestrum is uneven owing to superficial erosion. From without (Fig. II., *a*) the smooth floor of the second turn of the cochlea is seen with the regularly arranged apertures for the passage of vessels and nerves running spirally upwards on the modiolus. The upper part of the modiolus is broken off, the canalis centralis and spiralis modioli opening into the point of fracture. The central part of the lamina spiralis ossea, which divides the lower turn into scala tympani and scala vestibuli, is still present along the whole lower turn.

CASE IV.—*Necrosis of the lower and middle turns of the cochlea, including a part of the vestibule, with permanent facial paralysis.*<sup>1</sup>

Jas. Dallmeyer, fourteen months old. First seen Jan. 27, 1883, when he had a fetid discharge from left ear for seven months previous to this time. Lately frequent pain and insomnia, also repeated hemorrhages from left ear—for the last three months, according to the mother, he has not been able to close his left eye. Complete facial paralysis is now present. The auricle appears raised up from its insertion, presenting the peculiar right-angle appearance to the side of the skull so characteristic of an affection

<sup>1</sup> This case has already been briefly reported by me in the *Aerztliches Intelligenzblatt*, 1884, No. 49.



of the bony pars mastoidea in its anterior half. An incision, the result of an operation at other hands, is found directly behind the auricle, and is still open, the probe passed into the same glides inwards and forwards about 4 *cm*, but no bare bone is found; the probe passed into the auditory canal, however, strikes at once upon the sequester, quite close to the entrance. The next day under anæsthesia an incision 3 *cm* in length was made down to the bone, extending from the linea temporalis to the apex of the tumor behind the auricle, the pars mastoid. was found to be rough and bare, with a large hole in the bone filled with granulations which were scooped out with the sharp spoon. A row of small sequestra were then removed with forceps from the posterior wall of the auditory canal, and the probe in the external meatus could then be passed in 4 *cm* deep, measuring from the tip of the tragus. Drainage and iodoform dressing.

*January 31st.*—Dressing changed. Wound clean and without reaction. There is still a discharge from the auditory canal.

*February 7th.*—Discharge moderate and odorless. Wound communicates freely with auditory canal and pharyngeal space. Wound is funnel-shaped, with healthy granulations at the bottom. The probe passes into it about 3 *cm* deep, no bare bone being encountered. The fistulous opening was kept open, and the discharge from it was very slight, and without odor for a few months following, the child in the meantime getting stronger generally. At the beginning of July the discharge got copious again, and was at times bloody. There was a return of pain, especially when the ear was syringed. Insomnia.

*July 4, 1883.*—A new and larger sequester found in auditory canal and removed by the forceps, anæsthetics not being necessary. The sequester lay imbedded in granulations, and consisted of the greater part of the labyrinth, with exception of the semi-circular canals and inner wall of the tympanum. The probe could now be passed in 4 *cm* deep into the auditory canal, and here encountered bony resistance. It could still be passed into the fistulous opening behind, but no bare bone was met with.

After removal of the sequester the discharge became very slight, with quiet nights, and the fistula behind the ear closed up in a short time. The child remained under observation several months, a very slight odorless discharge still existing. It was impossible to examine the tympanum thoroughly owing to the narrowed auditory canal. It was, however, freely accessible from the

Eustachian tube, as shown upon injection into the meatus, the stream running down into the pharyngeal space. The facial paralysis persists unchanged.

*Sequestrum.*

(Heliotype Plate, Fig. III., *a*, *b*.)

The sequestrum embraces the same portion of the labyrinth as in the preceding case. On its outer surface is seen the base of the modiolus, with the first and the beginning of the second turn of the cochlea, and a considerable piece of the inner surface of the vestibule.

The lower turn of the cochlea, whose lateral wall is missing, as in the preceding case, shows the lamina spiralis ossea well preserved, and, as before, dividing it into two unequal parts, the inferior of which is continued forward to the anterior inner edge of the fenestra rotunda, with the crista semilunaris running transversely across it (Henle). The beginning of the scala vestibuli is well seen, including with it a large piece of the wall of the vestibule (the recessus hemisphæricus complete), and the greater part of the recessus hemiellipticus, between both the crista vestib. On the inner side (Fig. III., *b*.) almost all of the fundus of the porus acusticus is plainly visible; the greater part of the tractus spiralis foraminulentus is seen in addition to the different groups, for the passage of the vestibular filaments of the acusticus, including the ramus inferior, which passes through a separate canaliculus to the inferior ampulla. The canal for the facialis, as far as its hiatus at the genu forms a groove in the upper part of the sequestrum (Fig. III., above and to left). The bony wall of the porus acust. int. is smooth, as is also the side of the vestibule, the mouths of the canaliculi for the rami vestib. being somewhat enlarged.

I saw the child again Dec. 6, 1885, two and a half years after the removal of the piece of the labyrinth, and verified the following: There has been no return of the discharge, and no pain. Behind the auricle, and inferior to the linea temporalis, there is a deep depression, which takes in the greater part of the pars mastoidea. The auditory canal ends in a "cul-de-sac," at a depth of 19 *mm* measured from the apex of the tragus, the obstacle to further passage affecting bony resistance at all points except a small spot in the centre, where the probe, upon strong pressure, makes a slight impression. Tuning-fork *a*<sup>1</sup> upon the vertex is heard in healthy right ear. With right ear closed, *A*, *a*, *a*<sup>1</sup>, *a*<sup>11</sup>, are not heard through the air, while *c*<sup>1111</sup> is heard. The

facial paralysis is persistent and complete. The tongue is deflected towards paralyzed side, especially when forcibly thrust out. Muscles of the tongue anteriorly are equally well developed on both sides. The uvula remains straight when at rest, as well as during phonation. Owing to patient's youth it is impossible to test exactly the perception of taste in the region supplied by the chorda.

*Remarks.*—As it was impossible to test the hearing in this case during the course of the disease, owing to the youth of the patient, and the history being also somewhat obscure as to the beginning of the pain and other symptoms, our only “point d'appui” upon which we may base a supposition as to the time of the commencement of the labyrinth process is found in the facial paralysis, the appearance of which was noticed by the mother about nine months before the exfoliation of the sequestrum in the auditory canal. As the facial paralysis had already existed three months when the pars mastoidea was opened, and the sequestrum removed from the posterior wall of the auditory canal, it is very likely that the necrosis of the labyrinth commenced simultaneously with that of the pars mastoidea, the sequestrum proceeding from the former requiring a longer time for its exfoliation. Part of the sequestrum belonging to the first turn of the cochlea extends as far as the fenestra rotunda, and I think that we may safely conclude that the disease was in this way transmitted from the middle to the internal ear, as in both the preceding cases.

The sequestrum in Case III. showed on its inner surface a small piece of the wall of the porus acust. int., viz., a portion of the tractus spiralis foraminulentus; while the sequestrum in Case IV. shows a still larger piece of the internal auditory canal with smooth walls. The thickened dura mater with its outer granulating surface is, then, the only obstacle to an extension of the process to the pia mater and brain.

The atresia of the osseous auditory canal is also worthy of notice, and is accounted for partly by the necrosis of the posterior wall and the subsequent cicatrization, and partly by the constant and long irritation kept up by the sharp

edges of the sequestrum located at that position. It has, however, no bearing upon the future of the case, as the suppuration had completely ceased before the atresia took place.

CASE V.—*Necrosis of the whole labyrinth, with facial nerve intact.*

Mrs. Anna Stirnweiss, of Regensburg, forty-five years old, sent to me by her attending physician for the removal of a polypus in the left ear, with the remark that she had already had caries of the right temporal bone. The history, as obtained by me Sept. 19, 1885, is as follows: In her eighth year, R. otorrhœa from scarlet-fever, off and on—most severe from eighteenth to twenty-fourth year. In twentieth year, abscess behind ear broke and suppurated copiously for a year. Otorrhœa continued. In thirty-sixth year, perforation behind ear again. In thirty-ninth year, she removed a solid mass from the ear canal with a hair-pin—the sequestrum (Fig. IV.). L. otorrhœa for eight or nine years. A polypus removed with snare. Copious hemorrhage arrested with perchloride of iron. Loud voice, R, not perceived; L, at 16 cm.

*Status præsens.*—R: behind auricle a depressed scar, through the open centre of which the probe penetrates 19 mm deeper. The interior of the mastoid process is a large cavity, from which the probe and syringe remove epidermis having the characteristic odor of cholesteatoma. The meatus auditor. ext., with its mastoid extension, holds 2.8 gms of water.

The entire muscular distribution of the facial nerve is normal. Perception of taste in the anterior third of the tongue is present on both sides. A part of the left *Mt* (superiorly), including the handle of the malleus, seems to be present. The soft, closely trimmed root of the polypus was cauterized with the solid stick of arg. nitr.

*Sequestrum.*

(Heliotype plate, Fig. IV., *a* and *b*.)

The sequestrum exfoliated in this case includes the entire labyrinth, almost entirely shut in by walls on all sides, with smooth outer surfaces as though they had been polished. Its greatest length amounts to  $19\frac{1}{2}$  mm, greatest height  $13\frac{1}{2}$  mm, greatest thickness  $7\frac{1}{2}$  mm.

Its smooth inner surface (Fig. IV., *b*) shows two shallow

depressions taking in the greater part of its extent, divided from each other by a vertical seam or elevation. That toward the apex of the pyramid (Fig. IV., *b* left and above) represents the porus acust. int. changed into a shallow depression, while the one towards the base of the pyramid corresponds to the fossa subarcuata. The inner ear canal, notwithstanding its walls are perfectly smooth, has become flattened and is wider. The outer surface of the sequestrum (Fig. IV., *a*) is formed by the whole of the inner wall of the tympanum, and a considerable portion of the inner wall of the antrum mastoideum. The promontorium presents as a smooth polished elevation projecting from the former.

*Remarks.*—The morbid process resulting in this extensive sequestrum began at the age of eight years as a complication of scarlet-fever. It is impossible to decide whether the labyrinth was at that time implicated in the suppuration which led to its eventual extensive necrosis. Unmistakable indication of bone disease was first given by the fistulous opening behind the ear at the age of twenty years, the same closing up temporarily until her thirty-sixth year, when an opening was again established. Three years later the patient herself removed the sequestrum from the ear canal without difficulty. The condition of the sequestrum itself as described would seem to indicate that its exfoliation took place early in life, rather than at a later period. According to Volkmann<sup>1</sup> pus never effects a simple chemical disintegration of the bone, but changes it by producing inflammation, provided it be living bone. It has no influence whatever on dead bone, and the sequestrum may lie for years in its investing sheath, bathed in pus, without perceptible change.

#### *The Present Literature of the Necrosis of the Labyrinth.*

In order to get a better insight into the occurrence, ætiology, course, and sequelæ of labyrinth necrosis, with its resulting disturbances of function and complications, I have taken the liberty of appending a comprehensive compilation of cases as found in our later literature, as far as acces-

<sup>1</sup> "Handbuch der Chirurgie," von Pitha and Billroth, vol. ii., 2, 1, page 289.

sible to me, arranged in the order of their time of publication. I have also added my five cases, and in view of the universal interest in this form of disease, think it no imposition upon my readers to present these statistics in the following pages.

*Supplementary Remarks.*

Besides the cases mentioned in the statistics to follow, I remember also to have seen a case reported by Burckhardt-Merian. Richey's case (*Chicago Med. Journal*, vol. xxvi.), described in Politzer's text-book, was not accessible to me; likewise the exact history of Blake's case of exfoliation of the cochlea and walls of the vestibule, mentioned in the *Zeitschrift f. Ohrheilk.*, vol. ix., p. 388.

Since the completion of this article Kirchner has published a case of extrusion of the cochlea (*Münchener med. Wochenschrift*, No. 10, 1886); also Roosa and Emerson (last number of vol. xv., *Zeitschrift für Ohrheilk.*) have reported in detail a case in which almost the whole of the temporal bone, including the pyramid, was eliminated, this probably being the most extensive case of necrosis of the temporal bone resulting in cure ever reported. I have not been able to use these last two, they having reached me after my article was finished. There are probably a number of unpublished cases, and I may have overlooked some already published, but in spite of this I think forty-six cases quite sufficient to give my compilation a solid foundation.

*Bibliography of Forty-six Cases.*

(The German original contains a synopsis of the cases in tabular arrangement.)

CASE 1.—Linnekar, nach Tod, *Froriep's Not.*, Band xxxvi., p. 158, 1833.

CASE 2.—Crampton, *Praktische Beob. ueber Ohrenheilk.*, Wilde text-book.

CASE 3.—Ménière, *Gaz. méd. de Paris*, 1857, No. 50.

CASE 4.—Ménière, *ibid.*

CASE 5.—Giberto Schotti, *Schmidt's J.*, Band cii., p. 54, 1859; from the *Gazz. Lombard.*, No. 35, 1858.

- CASE 6.—v. Tröltsch, *Virchow's Arch.*, vol. xvii., p. 39, 1859, and *Ges. Beitr zur path. Anatomie des Ohres*, 1883, p. 106.
- CASE 7.—Shaw, after Toynbee, *ARCHIVES OF OTOTOLOGY*, vol. i., p. 113.
- CASE 8.—Hinton, *ibid.*, and in Böten's Inaug-Dissertation, Halle, 1875.
- CASE 9.—Toynbee, *ibid.*
- CASE 10.—Toynbee, *ibid.*
- CASE 11.—Toynbee, *ibid.*
- CASE 12.—Agnew, after von Tröltsch, *Arch. f. Ohr.*, vol. i., p. 158.
- CASES 13 and 14.—Gruber, *Allg. Wiener med. Zeitung*, vol. ix., 1864, Nos. 41, 43, 45.
- CASE 15.—Voltolini, *M. f. O.*, 1870, No. 6, Präparat von Jacobi.
- CASE 16.—Pommeroy, *Schmidt's J.*, 1873, vol. clx., p. 295.
- CASE 17.—Guye, *Arch. für Ohrenh.*, vol. viii., p. 225, and vol. x., p. 302.
- CASE 18.—Parreidt, after Schwartze, *Arch. f. Ohr.*, vol. ix., p. 238.
- CASE 19.—Böck, *ibid.*
- CASE 20.—Cassels, *ibid.*
- CASE 21.—Dennert, *Arch. f. Ohr.*, vol. x., p. 231.
- CASE 22.—Lucae, *Arch. f. Ohr.*, vol. x., p. 236.
- CASE 23.—Delstanche fils, *Arch. f. Ohr.*, vol. x., p. 301.
- CASE 24.—Spencer, *Arch. f. Ohr.*, vol. xi., p. 73.
- CASE 25.—Schwartze, *Arch. f. Ohr.*, vol. xii., p. 115, and observations made with v. Tröltsch and Burckhardt-Merian.
- CASE 26.—Dennert, *Arch. für Ohr.*, vol. xiii., p. 19.
- CASE 27.—Niemetschek, Prague, Schwartze's "Path. Anat.," p. 124.
- CASE 28.—Schwartze, *A. f. O.*, vol. xiii., p. 98.
- CASE 29.—Michael, *Zeitschrift für Ohrenh.*, vol. viii., p. 300.
- CASE 30.—Gottstein, *A. f. O.*, vol. xvi., page 51, supplemented by the history of Jacoby's case, *A. f. O.*, vol. xv., p. 295.
- CASE 31.—Schwartze, *Arch. für Ohr.*, vol. xvii., p. 111, in collaboration with Schede.
- CASE 32.—Politzer's text-book, vol. ii., p. 596.
- CASE 33.—Pollak, *St. Louis Zeitschrift für Ohr.*, vol. xi., p. 100.
- CASE 34.—Habermann, *Arch. f. Ohr.*, vol. xviii., p. 87.
- CASE 35.—Christenneck, *Arch. f. Ohr.*, vol. xviii., p. 293, from Schwartze's Poliklinik.
- CASE 36.—Moos, *Zeitschrift für Ohr.*, vol. xi., p. 235.
- CASE 37.—Jakoby, *Arch. für Ohr.*, vol. xxi., p. 54.
- CASE 38.—Jacobson, *A. für O.*, vol. xxi., p. 304, from Lucae's university clinic.





According to these figures age would seem to predispose during the first ten years of life. This, I think, is partly due to the predisposition to catarrhal and suppurative processes of the middle ear at that time of life, particularly the more severe forms following the acute exanthemata. On the other hand, this tendency in children to labyrinth necrosis, *as compared to the adult*, is explained also by the enormous difference in the proportionate size of the labyrinth at the different periods of life. At birth the labyrinth has already nearly attained its normal development; it is, proportionately, therefore, sixteen times greater in the infant than in the adult. Corresponding to this there is a remarkably rich blood supply of its bony walls as compared to the adult by the vessels of the fossa subarcuata.

Lucae<sup>1</sup> found the arteria subarcuata at seven months old almost as large as the art. auditiva int. Very numerous and large vessels pass into the semi-circular canals, and envelop the membranous canals with a vascular network. The importance of this as an ætiological factor of the inflammatory process in the bony labyrinth has been fully shown by Lucae in the interesting communication above mentioned. As is shown by the decreasing figures, the number of cases diminishes with advancing age. Over fifty-five years there is no such case on record.

### *Ætiology.*

The acute exanthema, especially scarlet-fever, seem to be a particularly important ætiological factor in labyrinth necrosis, as indicated by the large number of children attacked. The commencement of suppuration in seven of the cases tabulated was directly traceable to scarlatina, while measles were the cause in two cases. In the majority of cases of scarlatina where the middle ear is attacked, the *Mt* shows extensive ravages from the beginning, most always causing exfoliation of the ossicles. The primary acute suppuration of the middle ear does not necessarily attack the labyrinth at the same time, but, rather, extends to it after a greater

<sup>1</sup> *Virchow's Arch.*, vol. lxxxviii., page 556. "Ueber Hämorrhagie und hämorrhagische Entzündung des kindlichen Labyrinthes."

or lesser period of time. The repeated attacks lead to an accumulation of pus, which is never completely discharged, and the process gradually encroaches upon the realm of the internal ear with resulting necrosis. As shown by Burckhardt-Merian<sup>1</sup> and myself<sup>2</sup> the suppuration caused by scarlet-fever may, if left to itself, continue all through life, unless interrupted by some complication leading to a fatal issue. In the seven cases of scarlet-fever mentioned in the table, the time which elapsed between the commencement of the exanthematous process and the exfoliation of the sequestrum was as follows:

1. Case 34 (girl, five years), exfoliation one year after otorrhœa, a fistulous opening being established of the pars mastoid. simultaneously with the latter.

2. Case 40 (girl, four and three-quarters years) after one and three-quarter years; fistula of pars mast.

3. Case 7 (boy, seven years), after two and a-half years.

4. Case 26 (girl, seven years), four years after fistula of pars mast.

5. Case 36 (man, twenty years), thirteen years after.

6. Case 28 (adult, twenty years), demarcation of the sequestrum observed at the post-mortem fourteen years after scarlet-fever. Two fistulous openings of pars mast. which had existed for a year or more.

7. Case 46 (woman, thirty-nine years), thirty-one years after. An opening behind the auricle had existed for nineteen years.

From the above it is seen that necrosis of the labyrinth, as a sequel of scarlet-fever, makes its appearance years after the fever, and is frequently accompanied by destructive processes in the pars mastoid., leading to fistula of its external wall (in five of the seven cases). The necrosis following the two cases of measles shows a similar relation; exfoliation in Case 21 taking place four years after the fever, that of Case 24, twelve years after. In the first a sequestrum

<sup>1</sup> Volkmann's Sammlung klinischer Vorträge No. 182: "Ueber den Scharlach und seine Beziehungen zum Gehörorgan."

<sup>2</sup> Gesamtbericht über die 1881-1883 behandelten Ohrenkranke, *Arch. f. Ohrenheilk.*, Bd. xxi., p. 221.

had been already removed one year before, while Wilde's incision was necessary in the latter ten months previous to the exfoliation.

Symptoms of scrofula or syphilis were not found in the cases tabulated. Miliary tuberculosis was found in Case 19 (three and a half years, male) and Case 37 (fifty years, male) at the post-mortem, the remaining cases showing no signs of the same. There is, therefore, no reason to suppose, from the cases tabulated, that the different diatheses specially predisposed to the labyrinth necrosis. In the majority of cases we must make the inflammation of the middle ear, with the accompanying suppuration, responsible for it. In three cases the origin of the otorrhœa was traumatic. Case 5 (Schotti) had fallen from a ladder, striking upon the head. The suppuration did not take place, however, until two years after the fall. The ætiological connection is hence doubtful.

In Case 22 (Lucae), nine years before exfoliation, after a shooting match, had hemorrhage and pain in ear, with deafness since then. Traumatic perforation probably took place in this case; this leading to the otorrhœa years after.

In Case 42 (Bezold) loss of hearing and otorrhœa had followed a kick on the head, the symptoms disappearing three or four years later, but appeared again after a lapse of thirty-seven years. A vapor bath was given as the cause of this. Not quite four months later the greater part of the cochlea was removed from the ear canal. The reappearance of suppuration in this case after so long a pause was probably caused by the water penetrating through the perforated membrana tympani.

#### *Duration of the Morbid Process.*

Passing to the consideration of the duration of the suppurative process, the forty-six cases are to be divided into two categories:

1. The thirty-seven cases in which exfoliation and extrusion took place in life; and
2. The nine cases where death happened before elimina-

tion, the sequestrum remaining in place, showing more or less complete demarcation at the time of the post-mortem.

We are almost always justified in reckoning the duration of a suppurative middle-ear affection from the time of the beginning of the primary otorrhœa, when the same was of any consequence. This is also true of those cases where periods of time, more or less long, sometimes years, elapsed between the exacerbations, for, on the one hand, experience teaches us that an otorrhœa persisting for any length of time almost always causes extensive ravages of the *Mt* and middle-ear space, which do not permit of a spontaneous conclusion of the inflammatory process. On the other hand, a careful examination convinces us that the cessation of the suppuration is only apparent, and that the fetid odor still persists, with fluid secretion, in the depths of the ear, but in such small quantities that it is not discharged from the ear canal. A part of the secretion in such cases may find its way through the Eustachian tube; another part, becoming inspissated, remains in the osseous auditory canal.

Commencing from the beginning of the otorrhœa, as first remembered by the patient, we find the duration of the process, leading finally to exfoliation of the labyrinth, to be as follows:

GROUP I. (where extrusion in life):			
Duration.	No. of Cases.	Infectious Disease.	
2 to 8 months.	2		
1 " 2 years.	7	2 scarlatina.	
2 " 3 "	2	1 "	
3 " 4 "	2		
4 " 5 "	4	1 scarlatina, 1 measles.	
5 " 10 "	3		
10 " 15 "	2	1 scarlatina, 1 measles.	
More than 20 years.	2		
" " 26 "	1		
" " 31 "	1		
" " 32 "	1		
" " 41 "	1	Scarlatina.	
Several years.	2		
Unknown.	7		
Total . . .	37		

## GROUP II. (cases ending in death) :

Duration.	No. of Cases.	Infectious Disease.
8 months.	1	Phthisis.
2 $\frac{3}{4}$ years.	1	“
5 “	1	
7 “	1	
8 “	1	
12 “	1	Scarlatina.
More than 20 years.	2	
Unknown.	1	
Total . . .	9	

From the above summary is seen that in thirty-eight cases only two lasted less than a year before exfoliation of the sequestrum, and only one case where death resulted eight months after the beginning of suppuration. The rest of the patients had a discharge at least one year, most of them much longer; in twenty-one cases over four years, eight of the same having existed interruptedly or continuously for over twenty years. Now, according to the experience of surgeons, demarcation and exfoliation of a necrotic part of the skeleton, especially of such a small part as occupies us here, would hardly require a longer period of duration than one year. We are hence justified in supposing, at least in the majority of the cases, that the development of the necrotic process was secondary to the otorrhœa; further than this, we may also conclude, judging from the length of time occupied (in some cases, ten to twenty years), that it was not the primary otorrhœa, but one of the many exacerbations that influenced directly the destructive process involving the labyrinth.

Upon nearer consideration of the three above cases where the otorrhœa was of comparatively short duration, we find in the first case (Lucae, Bibliog., No. 22), in which the discharge had existed only eight months before exfoliation, that after attendance at a shooting match nine years before, certain symptoms were noticed, viz., pain, hemorrhage with subsequent deafness, indicating a traumatic lesion of the *Mt*, together with more extensive destruction. In the sec-

ond case (Jacoby, Bibl., 37) death was due to tuberculosis, and there was probably otitis media purulenta phthisica, which, as has been already demonstrated by numerous post-mortem observations, including my own, may lead, in a relatively short period of time, to extensive necrosis of those parts bordering on the diseased middle ear, the rapid course of the disease being due to the existing diathesis.

The case of Christinneck from Schwartz's polyclinic (Bibl., 35) forms a notable exception well worthy of emphasis. Not only was the duration of the suppuration remarkably short before the appearance of the necrotic cochlea in the ear canal (two months), but the course of the disease showed other peculiarities which do not appear in any of the other cases tabulated. The patient, a man of fifty-four, who was healthy previous to the beginning of Aug., 1880, was suddenly taken at that time with vertigo and faintness, followed by vomiting and pain in right side of head, the same continuing three days uninterruptedly. No loss of consciousness, but pain in region behind ear. Twelve weeks later, otorrhœa with remission of the pain, so that he could lie upon the diseased ear. Eight days after the appearance of the discharge the face was distorted.

The ear canal was already full of pedunculated polypi. Jan. 7, 1881 the necrotic cochlea was removed. It is a pity that this case was not under observation from the beginning. If we can rely upon the statements of the patient, we are almost driven to accept the supposition of a primary inflammation ending in necrosis of the labyrinth; the early phenomena, that of pain excepted, corresponding exactly to the characteristic symptoms of Ménière, coming prominently into the foreground. Twelve weeks later the discharge began, and eight days after this facial paralysis. This is, however, the only case among all of those tabulated, including my own, where the rapid course of the disease and the succession of the symptoms would indicate the labyrinth as the primary seat of the inflammation instead of the middle-ear space. In the great majority of the cases it is evident from the period of duration of the otorrhœa, that the labyrinth could only have been attacked secondarily.

*Inflammatory Phenomena.*

While the necrosing process was going on, the discharge was continuous and profuse, with a fetid odor which did not entirely disappear under antiseptic treatment, until the sequestrum had exfoliated. Among other inflammatory symptoms pain and the formation of polypi were the most constant.

In the forty-six cases mentioned pain was present in thirty; in thirteen of the cases the history leaves us in doubt as to its presence, while in three cases it is positively mentioned as having been absent. As its presence depends not only upon the labyrinth process itself, but also upon the inflammatory destruction of the middle ear, its duration may extend over a period of years, and is not confined to the ear, but involves the whole of one half of the head. Headache is mentioned in sixteen of the cases, but was partly due to meningeal and brain complications. The frequent participation of the pars mastoid. would lead us to expect mastoid tenderness; this was, however, not always present. The pain appearing in the last months of the disease was undoubtedly caused by the sequestrum itself, if not by the demarcation, at least by its passage when it reached that part of the osseous canal so richly supplied with sensory nerves. The continuous violent pain at this time makes the picture of disease a pronounced one. Many authors mention the peculiar anxious expression of countenance, this being also very apparent to myself. The insomnia, lasting weeks, perhaps months, causes considerable disturbance of nutrition, and the patient becomes pale and thin, presenting a cachectic appearance. Where there are no complications, pain disappears with the removal of the sequestrum. Great relief is also given by the removal of the polypi, which obstruct the discharge of pus and the emigration of the sequestrum. After the removal of the sequestrum the patient recuperates in a most remarkable manner, and one is often astonished to see the previously decrepit individual a strong hearty man a few months after. Temperature and chills were reported in only a comparatively small number of the cases, and then seemed to

have been caused by extension of the suppurative process to the meninges, sinuses, and the soft parts of the pars mastoid. In two cases where the sequestrum made its exit through a fistulous opening behind the ear, fever was present from beginning to end.

Demarcation and passage of the sequestrum through the tympanum and ear canal, accompanied by fever, seemed to be the exception (Moos' case, *Bibl.*, 36). Polypoid proliferation was present in all cases of exfoliation before death, the same being partly developed before the implication of the labyrinth by the influence of the middle-ear process, and are always present at the time of the passage of the sharp-cornered sequestrum through the ear canal. In the most intense cachexiæ, especially the last stage of phthisis, there seems to be an insufficient formation of granulations, and in these cases there is also no extrusion of the sequestrum, the same remaining in its original situation. The polypoid proliferation is most abundant in the tympanum, edge of *membrana tympani*, and external ear canal; also, as shown by von Tröltzsch (*Bibl.*, 6) in the Eustachian tube. They may completely fill the auditory canal, projecting from its external opening,—pedunculated forms being found, as well as the true polypi (with epithelial covering, etc.); more seldom a diffuse granulation tissue forms on the walls of the canal. As long as the sequestrum lies imbedded behind these polypoid proliferations (which bleed easily), they sprout forth again as fast as removed, until the extraction of the sequestrum, when rapid involution takes place. In the 37 cases ending normally by exfoliation of the sequestrum, polypi or simple granulations were present twenty-seven times.

Fifteen of these were true polypi with pedicles, or at least growths requiring removal with the snare. Twelve are simply described as proliferations or granulations, while in only ten of the cases, mostly with very brief histories or of long date, no mention whatever is made of proliferous growths. Also, in the nine cases where death ensued before complete demarcation or change of position of the sequestrum, six showed polypi. Von Tröltzsch



(Bibl., 6) found the origin of the same in his case to be in the ear canal, on the edge of the *Mt*, and in the Eustachian tube, while Schwartz (Bibl., Case 28) found they originated in the tympanum. In the other three cases, no mention is made of their presence whatever.

### *Disturbances of Equilibrium.*

Ever since the experiments of Flourens the labyrinth has been thought to be an organ of the sense of equilibrium, and clinical experience confirms this supposition most satisfactorily. The very frequent occurrence of disturbance of equilibrium with disease of the organs of hearing, especially of the nervous apparatus, leaves no doubt in our minds that in the labyrinth we have an organ for the preservation of the equilibrium. An almost unmistakable indication of this is seen in its anatomical structure, with the semicircular canals arranged in planes perpendicular to each other. By reference to the preceding statistics, we find that such disturbances were noticed in only a fractional part of the cases, and then mostly at the beginning, and lasting only temporarily. More than this, it is very probable (almost sure) that in a number of cases the vertigo was due to direct cerebral irritation caused by meningitis or cerebral abscess, and consequently would not here be considered. In the forty-six cases there were only twelve in which vertigo was positively mentioned as a symptom; in four of the cases under three years it was not observed, while in twenty-three cases no mention is made of it whatever, although in other respects the history is in detail. It is therefore reasonable to suppose it was absent in the majority of these cases. In seven other cases positive mention is made of its absence. In the twelve cases where it was present, the vertigo appeared once in one and a half months, once in three and a half months, twice in five months, once in six months, once in eight, once in nine, and once in eleven months, before the removal of the labyrinth by spontaneous or operative means (Bibliography, 36, 25, 35, 40, 9, 22, 18, and 24). In one case (Bib., No. 12) the symptoms had existed "for months," and in still another (Case 37) vertigo with noises

in the ear appeared eight months before the post-mortem, at which time the labyrinth showed complete demarcation. It is often stated that the disturbance of equilibrium commenced at the time of the beginning of the otorrhœa, or an exacerbation of an old discharge, with increase of pain in head and ear, and in Case 35 of Christenneck, which has already been specially mentioned owing to its peculiar course, it even preceded suppuration by twelve weeks. Repeatedly the vertigo was coincident with the appearance of facial paralysis. Vertigo is therefore not regularly present as an initial symptom of labyrinth necrosis; but we are justified in connecting it with the beginning of the extension of the suppurative process from the middle ear to the labyrinth. It may be absent entirely, when the affected ear was completely deaf beforehand, as in Case 44, described by me. Also at this period it does not seem to be dependent upon the labyrinth affection itself, but rather owing to the cerebral and meningeal complications. In Case 18, for instance, in addition to the vertigo existing nine months before extraction, constipation, headache, and vomiting were also present, these being attributed by the author himself to meningeal irritation. In Case 24 vomiting, delirium, attacks of insensibility, and violent headache coexisted eleven months before extraction.

Case 25 showed violent vomiting and fever.

In Case 36 there were coexisting chills, with elevation of temperature; later on, however, vertigo and vomiting were again noticed without the above abnormal symptoms. The last attack was only two days before the appearance of one of the semicircular canals. Finally, at the post-mortem in Case 28, Schwartz discovered a small cerebellar abscess with firm walls, which had doubtless already formed at the beginning of the vertigo. Disturbances of equilibrium have been noticed exceptionally after exfoliation of the sequestrum. This is not due to the absence of the labyrinth, but rather to continued irritation of the centre of equilibrium. The following are examples of the same:

Case 18: After extraction, patient otherwise healthy, "but after violent exercise still a trace of vertigo." The

pronounced vertigo before exfoliation in this case was ascribed to meningeal irritation.

In Case 35 vertigo was noticeable afterwards only in the dark.

In my own case, No. 42, I thought I remarked a slight uncertainty in the gait with closed eyes, patient declaring himself, however, completely free from vertigo. In all of the remaining cases where disturbances of equilibrium were noted they disappeared entirely after elimination of the labyrinth.

In a single case (No. 20) pronounced disturbance of equilibrium and vertigo were first noticed after exfoliation of the labyrinth. This, however, was followed by further exfoliation, with coexisting frequent syncope, vomiting, and other constitutional symptoms indicating cerebral implication. Besides this there was a suppurative middle-ear process of the other side, with the formation of polypi, so that this case would not be taken into consideration here.

#### *Subjective Noises.*

I have subjected the histories of all of the forty-six cases to special scrutiny, and have only found three cases where subjective sounds were complained of. In my own five cases they were absent. The three cases are as follows:

1. (Toynbee, Bibl., Case 9.) Otorrhœa had here existed off and on for twenty years, becoming copious in the last two years. The more acute phenomena of inflammation began six months before the extraction of the sequestrum, and simultaneous with a more copious discharge there was violent pain of the side of the face implicated, with "a pulsation and noise like the puffing of a locomotive" in the diseased ear. A few days later a temporary facial paralysis made its appearance.

2. (Cassels, Bibl., No. 20.) A very loud noise was complained of in the last months before extraction of the sequestrum. A chronic suppuration of the middle ear existed on the opposite side.

3. (Jacoby, Bibl., 37.) In this case the discharge from the middle ear commenced eight months before the death of

the patient from phthisis, and was preceded by tinnitus and deafness by six or eight weeks. This, according to my experience, is often the case in otitis media purulenta phthisica; tinnitus and impairment of hearing here often preceding the perforation (mostly painless) and rapid decomposition of the drum-head. As soon as the middle-ear space is laid bare, necrosis takes place rapidly and almost without symptoms extending to the internal ear. According to this the process, which resulted in the partial elimination of the pars petrosa, had not commenced at the time tinnitus was reported.

In the cases of double exfoliation (Bibl., 13, 14) of the cochlea, Gruber inferred from the boys' confused statements that subjective noises were present. There are, therefore, only two cases among the forty-six in which the presence of subjective noises was demonstrated with certainty. In both cases the noises were noticed only before exfoliation, and in Toynbee's case were undoubtedly an initial symptom of extension of the suppuration to the labyrinth. Continuance or reappearance of the noises after the cessation of the necrosing processes is not reported in any of the cases, absence of the same being especially mentioned in some of them. That subjective noises are of rare occurrence in labyrinth necrosis, as is conclusively shown by my statistics, seems to me to be a not unimportant addition to our knowledge of the usual seat of these symptoms, which so tax the patience of both doctor and patient, and whose origin is still shrouded in a veil of mystery.

I remember that my never-to-be-forgotten teacher, von Graefe, in one of his lectures, once warned us against enucleation of the eye for the relief of photopsia in cases of amaurosis, as he was convinced that it often persisted unchanged after the operation, thus showing it to be of central origin. The organ of hearing, according to the conclusion arrived at above, does not seem to bear an analogous relation to that of sight in this respect. The atrophy of the acoustic nerve develops centripetally and would eventually involve the central organ itself; hence we might expect the occurrence of subjective noises, just as we expect

photopsy in certain cases of amaurosis. The complete absence of them, however, in a comparatively large number of cases, justifies us in the supposition that, unlike analogous phenomena in the eye, they have their origin, at least as a rule, in the labyrinth itself or its appendages, and in exceptional cases only are they due to disease of the more centrally located organs. The fact that this symptom is so seldom present at the beginning of the necrosing process leads us to think that the seat of the noises is more easily and rapidly destroyed than the end-distribution of the rami vestib. in the ampullæ, whose irritation, judging from the preceding destructions, would seem to cause the vertigo and disturbance of equilibrium.

### *Tests of the Hearing.*

The result of the hearing tests requires also a somewhat more searching critique. It is quite natural to suppose that destruction of the peripheral organs of perception and complete loss of the function of hearing are inseparable companions; there are, however, some authors who have abandoned this hypothesis, which we thought so self-evident as a mathematical axiom. In our table the following facts are specified:

In seven cases a definite opinion as to the hearing could not be arrived at, partly owing to the youth of the patient, and partly because of the patient's drowsiness.

In eleven cases very indefinite notes are given. In Case 7, for instance, deafness is first reported, and later on hardness of hearing. In Case 31 the hearing was tested three weeks before the post-mortem (which showed complete demarcation of the labyrinth at least on the side towards the tympanum). The watch was not heard, but the tuning-fork upon the vertex was recognized with the diseased ear.

In Case 42, reported by myself, the tuning-fork *a'* was heard through the air several weeks before exfoliation; watch and gentle voice, however, were not perceived. I did not see the sequestrum myself in this case, but according to the declaration of the attending physician it was either a piece of the cochlea or a semicircular canal.

In twenty-three cases, four of them my own, complete deafness was observed.

In five cases there seemed still to be a greater or lesser capacity for hearing in the diseased ear after exfoliation of more or less of the labyrinth; in fact, in four cases of the cochlea itself. These are the following:

1. Case 17 (Guye). According to the reports of the "*Versammlung der deutschen Naturf. und Aerzte*," a child of five years heard the watch at a distance of 2" to 4" after exfoliation of a sequestrum containing the posterior half of the vestibule and the semicircular canals. The hearing distance of the other ear is not given.

2. Case 20 (Cassels). After exfoliation of the sequestrum, consisting of the well-characterized cochlea (shown by Schwartz in an illustration), the patient, two years old, heard the watch at about 1", also words of one syllable at 16', and distinguished with certainty all the notes on the scale of the piano: C' and C were equally well heard through the bones of the head as at a distance of several inches; all this with the other ear thoroughly occluded. About six and one half months before exfoliation the watch was not heard when placed on the bone, and the tuning-fork only slightly perceived, whilst loud conversation was heard only when in the immediate vicinity. During the gradual elimination of the sequestrum on the side tested, there was an existing middle-ear suppuration with the formation of polypi on the other side.

3. Case 35 (Christenneck). The patient, fifty-four years of age, does not hear the tuning-fork c; three weeks after the removal of the necrosed cochlea, with the corresponding resonator on the vertex, however, he locates its tone in the affected ear; three weeks before this he heard it equally well in both ears, when placed on the vertex. On the other side the watch is heard at a distance of 3 cm.

4. Case 38 (Jacobson). A week before death the twenty-nine-year-old patient, whose right ear was normal, heard whispering voice S near the ear, equally well by closed or open ear canal; c most strongly struck, not heard; f''' sharp, at 8". c with bone-conduction heard with diseased ear. The last was also reported on the day of death. Upon post-mortem, the only remaining portion of the cochlea was found to be a small necrotic piece of the lamina spiralis.

5. Gruber's case, No. 39. After removal of the sequestrum containing the cochlea (shown by Gruber in an illustration) by means of the syringe, the patient, æt. fourteen years, hears watch when laid on jawbone or mastoid process (on right normal side watch perceived 145 *cm*). The sound produced by running the finger over the small ordinary tuning-fork is heard with the affected ear, as well as other tuning-forks; one of the same placed upon the finger occluding the diseased ear, was also heard by it; according to the statement of the patient, "moderately loud-spoken words are heard quite well with closed, right, normal ear, and with the aid of the ear-trumpet appreciates whispered conversation with the left ear, and repeats the words after me." A similar test by means of the voice with closed left ear-canal was not made.

These five positive results as obtained by the hearing tests, conflict decidedly with our physiological theories as to the special function of the end-distribution of the sensory nerves, and we have therefore every reason to be cautious in drawing any conclusion from them, especially so as to the statements of the patients themselves. Otherwise we would be compelled to invest the trunk of the acoustic nerve, which normally is only the path over which the impression travels, with the power of appreciation and reception of direct irritation. This would amount to just as much as supposing (and I think the analogy quite justifiable) the stump of the optic nerve after enucleation capable of receiving and transmitting impressions produced by the waves of light falling into the empty orbit. Luckily a disproportionately large number of cases with negative results stand in direct opposition to this.

In Guye's case, where the sequestrum embraced only the posterior half of the vestibule with the semicircular canals, there is perhaps a possibility that the terminal nerve twigs in the cochlea still partially preserved their function, notwithstanding the destructive process in the immediate vicinity. I can, however, hardly bring myself to accept this conclusion, as the fenestra ovalis must have been included in the destruction. In the other four cases it was the cochlea itself that suffered. While we do not believe

the cochlea the sole organ for the perception of sound (which conclusion, nevertheless, becomes more and more justifiable), we may, however, infer that in all probability the soft parts of the remaining labyrinth, as well as in the cochlea, were destroyed; and this was shown at the post-mortem examination in Jacobson's case (No. 4), where a carious excavation, filled with granulations and cheesy matter, had taken the place of the labyrinth. The inference that the hearing is completely lost with destruction of the labyrinth, in my opinion, rests upon a more solid foundation than our hearing tests. For this reason it seems to me that the cases of labyrinth necrosis are more than usually valuable material, upon which the reliability of our approved tests of hearing themselves is to be verified, rather than the deduction of opposite conclusions, based upon doubtful results gotten from ears in which, although the cochlea is wanting, the power of hearing is still more or less present.

*One of the principal sources of error in our tests of hearing is the difficulty and partial impossibility of the complete exclusion of the other ear from the act of hearing.* The presence of the smallest opening in the auditory canal still suffices for the almost normal perception of sound. One may easily convince himself of the truth of this, in cases of inspissated cerumen, where the auditory canal is apparently completely occluded. Should there, nevertheless, be the smallest passage, however devious, or chink, however small, through which the waves of sound may pass, no very perceptible diminution of the hearing distance is obtained.

The slight influence of a narrowing of the auditory canal is especially noticeable in solitary exostoses, with broad bases.

I have at present such a case under observation, where the bony growth has so occluded the canal that the passage of a small probe is impossible; more than this, the remaining chink is partially filled with epidermic scales, and the affected ear shows almost normal hearing. This remarkable fact is well known, and easily explained.

With the finger, it is just as it is with an exostosis. Although the forefinger in size and form is quite well adapted



to the complete occlusion of the entrance of the ear canal, a few hairs more or less thick, growing in the canal, may render it impossible to hermetically close it. Where this obstacle is not present, strong pressure with the finger is necessary to conform it exactly to the shape of the entrance to the meatus, and this, as may be demonstrated upon the cadaver with only moderate pressure, causes a strong movement of the *Mt* inwards, which imparts a sensation any thing but agreeable, as I can testify from personal experience.

Our tests of hearing, as universally practised, intrusting the occlusion of the ear not under examination to the patient himself, offer for this reason a very doubtful guaranty of the thorough exclusion of the other ear. Our experience has taught us that it is impossible to test the sight accurately if we allow the patient to obstruct the sight of one eye by covering it with his hand, as it is well known that he removes it when we ask him a question, thus disturbing the test and making a bandage over the eye necessary. The same is the case when we intrust the patient with the duty of thoroughly closing his ear. This element is so important that it threatens to overturn our fundamental physiological theories as to the function of the ear, as seen in the cases where, with the labyrinth missing, apparently positive results were obtained. The precaution should at least be taken of confiding the closing of the ear to a reliable assistant. Whether this was the case or not in the five cases cited is not mentioned. In addition to this, in making such tests the ear under examination should also be closed, as was done by Dennert and Lucae, in order to satisfy one's self that the other ear is really thoroughly excluded from the test. Further than this, perception of the majority of the sources of sound reaching our ears is not prevented by the complete hermetical sealing of the entrance to the ear canal. We may convince ourselves of this in the following simple manner: standing upon a stool in order to eliminate transmission through the floor, both ears being tightly closed with the forefinger, in spite of this we may hear every single note of the scale of the piano with facility; in fact, the

higher the note on the scale, the better it is heard. The same is experienced with medium loud conversation, which is heard at a considerable distance with both ears completely occluded. Distinctly enunciated whispering gives the same result, and it is only when one whispers with lessened impulse of expiration that the sound is extinguished. The safest and most adapted method for testing unilateral deafness is the use of the tuning-fork through the air. In the tuning-fork we have a sufficiently weak source of sound, owing to the fact that the tone is given off in a very slight degree, so that the other ear may be left entirely out of consideration, it not being even necessary to close the same, at least with the deeper tuning-forks. Nevertheless, we may increase the intensity of the tone by approaching the instrument close to the ear under examination.

Since the strength of the sound diminishes in reciprocal proportion to the square of the distance, the tuning-fork gives us a great advantage over the piano and the voice. Its branches may also be held directly in the concha.

The deeper-toned forks are the only ones adapted for this examination, and these must be as free as possible from high tones.

After this unavoidable general discussion, let us consider the above five cases somewhat more in detail, beginning with Guye's case, where the patient was only five years of age, and in addition to this was tested with the watch only, which, as we all know, is so apt to mislead, that I hardly think the results obtained in this case worthy of further consideration, in view of the important question involved.

In the third case, of Christenneck, the tuning-fork *c* was only heard when the "resonator" was used; hence bone-conduction in this case would not be excluded, for the powerful waves of sound originated in the resonator pass along its walls to the bone, and thence are transmitted to the normal ear upon the other side. The results obtained in this case by means of Weber's method may be also disregarded, as different results were obtained at different times. In Case 4, of Jacobson, the whispered voice, with both open and closed ear, was equally well heard—that is to say, quite

badly heard. Tuning-fork c sharp'''' was heard 8'' too short by the diseased ear. Since, however, the other ear was normal, this note, as well as the voice, would have been heard even with occlusion of the diseased ear (about which nothing is noted), as has already been discussed, as well as the uncertainty of the patient's statements in Weber's method. There remain, therefore, only the cases 2 and 5 of Cassels and Gruber. The fact that the patient understood words of one syllable spoken in a moderately loud voice, at a distance of sixteen feet, would not be positive evidence against deafness, since the moderately loud voice is still heard by the normal closed ear at a considerable distance; but, in addition to this, the watch was heard at one inch, and the tuning-forks C' and C, not only when placed upon the bones of the head, but also at a distance of several inches. This apparent improvement of the hearing distance in an ear from which the cochlea had been removed would seem the more remarkable when compared with the result obtained six and a half months before exfoliation, at which time the loud voice was only heard in the immediate vicinity. In order to interpret correctly the significance of these differences in the hearing at different periods of time, we must not lose sight of the fact that a suppurative polypous inflammation of the middle ear existed upon the other side, which is sufficient of itself to produce apparently great differences in the hearing capacity of the deaf ear. The statement that the patient heard all the notes of the scale distinctly, seems to me to be somewhat doubtful. It has also been mentioned above that this is possible with the completely closed ear. Schwartze himself, in presenting a translation of Cassels' case in the *Arch. für Ohrenh.*, does not hesitate in declaring the apparently positive result of the hearing tests to be a delusion.

As far as the last case (Gruber's) is concerned, the hearing of the watch when laid upon the jawbone and the mastoid process of the diseased side is to be disregarded, for the other, in this case normal, ear was not excluded, owing to the bone-conduction of young subjects. Also the perception of the tuning-fork placed upon the finger occluding the

diseased ear has little significance, for this method, recently recommended by Gruber, is simply a transmission by aerial and osteo-tympanal conduction combined, and does not exclude the other ear. The positive result of the test with the whispered voice is of little import, because of the absence of the counter-test with simultaneous closure of the diseased ear. The appreciation of the small *a''* tuning-fork through the air might seem the most remarkable of all. I have, however, with special reference to Gruber's case, tested one of my patients (Bibl., 44) with the same small tuning-fork in the manner mentioned, and obtained the same result as Gruber, although the hearing in this case was not even normal upon the other side, while the deeper tuning-forks, whispered voice, and the noise of Hedinger's acoumeter, when laid upon the diseased ear, were positively not heard in the slightest degree. The ear had shown itself absolutely deaf to all other tests. In my first case (Bibl., 42) the tuning-fork *a'* was apparently heard a month before exfoliation, although the ear was absolutely deaf to whispered conversation. A possible explanation of these strange phenomena might be given as follows: While the normal auditory canal is attuned to a much higher note lying in the four-marked octave, the considerable enlargement of the canal, due to its free communication with the middle-ear space, results in a much deeper tuning of it, and under this hypothesis the more powerful standing waves originating in the canal may pass on to the bone, and thereby be transmitted to the opposite ear. A certain and sure proof of the absolute deafness resulting from loss of the cochlea is only to be obtained in cases of bilateral exfoliation, and we are indebted to Gruber himself for the observation of such a one (Bibl., 13 and 14). In this case there was complete deafness upon both sides to the voice with the ear-trumpet, noises, musical instruments of all kinds, as well as the whistle and tuning-fork. Subsequently the patient, a boy of twelve years, became a deaf-mute.

#### *Facial Paralysis.*

The following are the results of the observations of the facial nerve :

In eleven cases, the histories of which are mostly very brief, there are no reports, or very unreliable ones, my own case (Bibl., 46) being included among these. As to the remaining thirty-five cases, incomplete implication of the facial nerve was observed in six cases only; in three of these the necrosis was limited to the cochlea exclusively, in one to the cochlea and a small portion of the vestibule; in a fifth, one of the semicircular canals was the sole lesion, while in the sixth case there was extensive caries of the labyrinth with exfoliation of the lamina spiralis, as shown by post-mortem.

In four cases with fatal issue before removal of the sequestrum the paralysis existed until death.

In one other case, also fatal, it was impossible, owing to the stupid condition of the patient at the time of the examination, to determine whether complete paralysis or only paresis existed. In two of these the post-mortem showed partial demarcation of the necrotic labyrinth; in one case, of the cochlea and other portions of the pars petrosa; in another, sequestration of the whole posterior section of the petrous portion was observed; while in the fifth case the cochlea, with a part of the carotid canal, was found lying in the external auditory canal.

In one case, where the only symptom was twitching of the muscles supplied by the facial, this happening two weeks before death, the post-mortem showed necrosis and partial exfoliation of the entire labyrinth together with the porus acust. int.

In three cases without fatal termination, the subsequent condition of the facial nerve is not mentioned, although complete facial paralysis existed during the period of exfoliation. In these three cases the sequestrum included once the entire apex of the pyramid with labyrinth and porus acusticus int., once the whole labyrinth, and thirdly the cochlea.

In four cases the paralysis was only a temporary manifestation, appearing during the process of exfoliation, and disappearing when the same was completed. In three of these the extruded sequestrum proved to be the cochlea, while in the fourth it was either a turn of the cochlea or a semicircular canal.

In six cases there was only partial recovery from the paralysis. Here the sequestrum in one case embraced the pars petrosa entire, with the external osseous ear canal and a part of the mastoid process; in another, a part of the pars petrosa with the semicircular canals and a portion of the mastoid process was verified; a third case included the whole of the labyrinth; while a fourth showed a part of the vestibule with the semicircular canals; finally, the last two were parts of the cochlea. In the ten cases remaining of the forty-six tabulated, it is distinctly mentioned that the facial paralysis persisted permanently after the elimination of the sequestrum. In the first of these the necrotic process attacked the upper part of the inner wall of the tympanum, taking in a part of the fenestra ovalis and the facial canal; in the second, the whole labyrinth, porus acust. int., and the posterior wall of the bony ear-canal were included; another showed a large piece of the pars petrosa with the labyrinth and pars mastoidea besides; a fourth was verified as the base of the cochlea alone; while a fifth embraced the cochlea with a large part of the inner vestibular wall, the porus acust. int., and the commencement of the canalis Fallop. In the five cases remaining, the sequestrum included the whole or portions of the labyrinth.

As is seen from this summary, in thirty-five cases of labyrinth necrosis, paralysis of the facial nerve existed in twenty-eight, while one case showed irritative disturbances only. The facial nerve was hence implicated in eighty-three per cent. of the cases, and *its involvement is therefore one of the most frequent symptoms of the presence of necrosis of the labyrinth.* The intimate connection between the canalis Fallop. for a great part of its course and the labyrinth explains very satisfactorily this frequent participation. The course of the facial nerve in the temporal bone may be divided into four sections, which lead to entirely different sequelæ, according as they are implicated in the exfoliation of different parts of the labyrinth. The first part of its course within the porus acust. int. was included in the morbid process in all those cases where exfoliation of the entire labyrinth resulted, the fundus of the canal being regularly attacked; in

fact, it is quite frequently mentioned that the whole or part of the porus acust. int. was included in the sequestrum. In eight out of the ten cases with permanent paralysis, the porus acust. int. was partially or totally included in the exfoliated sequestrum. This was also the case in three out of the six cases where partial recovery from the paralysis resulted. On the other hand, in the ten cases where the nerve was not affected, or the paralysis of temporary duration, no part of the porus acust. int. was included in the sequestrum, when we except the tractus foraminalentus, which was more or less extensively implicated. In my own case (No. 46), however, there was not a trace of paralysis in after years, notwithstanding that the sequestrum contained the whole of the por. acust. int. I shall refer to this case in detail later on.

The partial or total exfoliation of the porus acust. int. is followed, therefore, in the majority of cases by a permanent, partial, or complete loss of function of the auditory, as well as the facial nerve. This is, however, not the case with the second section of the path of the nerve, which extends from the beginning of the canalis Fallop. to its knee (only a few millimetres long). This part of it lies above the cochlea, and hence is not necessarily prejudiced by the destructive process; immediately after its passage from the internal meatus into the canalis Fallop. the nerve runs, however, directly over the superior portion of the first turn of the cochlea, and exfoliation of the same is very likely to be followed by simultaneous perforation into the facial nerve canal at this place, as the bony wall between is something less than one fourth of a millimetre thick. I have verified this measure upon a large number of my own preparations, and find it to be relatively constant.

In only one of the cited ten cases of permanent paralysis was the sequestrum composed of the cochlea alone, while two of the six cases of permanent paresis produced a sequestrum formed exclusively by the cochlea. On the other hand, the sequestrum in three of the cases of temporary paralysis included parts, or all, of the cochlea. (I have not added my own case, 42, to these, as I did not myself see the

fragment exfoliated. It was said to be a part of the cochlea.) In five of the six cases where paralysis was wanting, the cochlea was more or less implicated, the necrotic process in the sixth being limited to one of the semicircular canals.

*In spite, therefore, of the immediate neighborhood of the facial to the morbid process, permanent disturbance of its function is the exception in necrosis of the cochlea, and in most cases its elimination of the cochlea is attended with temporary disturbance only, or none at all ; a conclusion which Schwartze has already arrived at, though with a smaller number of cases.*<sup>1</sup>

The facial nerve is in more danger when it enters the third section of its course, extending from the knee horizontally backwards, at first over the median wall of the bony tube, and then along the internal wall of the tympanum, to the point where it bends a second time to pass down in a vertical direction. As far as the relation of this tract to the cochlea is concerned, however, when the sequestration is not extensive, it is better protected than the first part of the commencement of the canal. Fallop., being above the cochlea and farther away from it than the latter. Elimination of the cochlea may then occur without perforation of any part of the canal, except the very first part of section two, described above as being only separated from the cochlea by a very thin shell of bone. Necrosis of the labyrinth, on the contrary, is much more dangerous to the third section of the canal ; exfoliation of the bony vestibular walls, especially with implication of the semicircular canals, if only their beginning, being simply impossible without division or involvement of a greater part of the canal in the necrotic process. This is at least true of the majority of cases where exit is found through the tympanum and auditory canal, avoidance of the canal being only possible in those exceptional cases in which the sequestrum passes through the mastoid antrum with secondary necrosis of the pars mastoidea and the formation of an external fistulous opening. Corresponding to this, we find in seven of the ten

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<sup>1</sup> *Arch. f. Ohrenheilk.*, Band xii., page 120.



cases of permanent paralysis cited, complete exfoliation of the entire labyrinth, with partial implication of other parts of the petrous bone; in another case, a larger part of the inner vestibular wall extruded; while still another involved the cochlea alone, the tenth and last case having attacked the facial canal itself, including a part of the fenestra ovalis. Moreover, in direct opposition to this, in none of the six cases where the integrity of the facial was preserved, is extensive necrosis of the vestibule or semicircular canals reported, the process in four of the cases being limited to the cochlea, in one to the cochlea including a small portion of the vestibule, and in the last to one of the semicircular canals. Necrosis of the whole of the labyrinth is, therefore, followed by permanent paralysis. (There are also exceptions to this rule, as will be seen further on.) Passing, finally, to the consideration of the fourth section of the Fallopian canal, extending from its second turn to the foramen stylomastoid., we find that it is seldom exposed to primary destruction by demarcation of the labyrinth, but may be affected secondarily, especially when the sequestrum makes its exit through the mastoid antrum. This is, of course, also possible when the necrosis extends from the labyrinth to the posterior tympanal wall and central parts of the mastoid cells, or implicates the posterior wall of the osseous auditory canal; as happened in two of the permanent paralysis cases, and also in two with subsequent permanent paresis.

At the post-mortem in Case 31 (see Bibliography), Schwartze found that the trunk of the facial nerve between the knee and the second bend had been squeezed flat by the granulations surrounding the sequestrum. It is thus seen that although the nerve may not be pressed upon or torn by the passage of the sequestrum itself, the pressure exerted by the granulations developing in its line of demarcation is quite sufficient to completely interrupt the conduction of nerve impulses.

It is a well-known fact that temporary paralysis and paresis of the facial nerve is caused every now and then by extension of an old putrid suppuration of the middle ear of years' standing, through a pre-existing or newly formed

opening in the facial canal, at any point of its course through the temporal bone. A series of such cases has been reported in H. Tillmanns' dissertation.<sup>1</sup> I would, however, emphasize the fact that this temporary paralysis produced by simple middle-ear suppuration without destruction of the bone, or even by acute catarrh of the middle ear, is of very rare occurrence. In support of this I find that in 850 cases of suppuration of the middle ear, noted in my last three-yearly report,<sup>2</sup> only 9 developed facial paralysis; 227 of the above cases were acute, while 623 were chronic, including formation of polypi, caries, necrosis, cholesteatomata, and otitis media purulenta phthisica. I can answer for the correctness of this statement, as it is my habit to inspect the patients myself at the time of their reception, for the purpose of establishing the diagnosis. The frequency of facial paralysis in purulent suppuration of the middle ear is hence to be rated at a little over one per cent. Two of these nine cases are included in the table of labyrinth necrosis (Cases 42 and 43).

In the third case, reported elsewhere,<sup>3</sup> the permanent facial paralysis in the  $1\frac{3}{4}$  year-old luic child was due to necrosis of the whole annulus tympanicus, which was removed by operative procedure. The fourth case was a phthisical woman in whom the characteristic otitis media purulenta appeared in the right ear one year before death. She presented herself for treatment six months after this, at which time the *Mt* was already totally destroyed with loss of hearing. This was followed subsequently by exfoliation of hammer and anvil.

Facial paralysis developed two months before death, beginning with fibrillar twitchings throughout the muscular distribution of the facial, these disappearing nine days later from the orbicularis with resulting lagophthalmus, but persisting thirteen days longer around the mouth and chin, from which time on complete paralysis of the entire muscular distribution was established, which persisted until death.

Post-mortem showed extensive caries necrotica with perforation

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<sup>1</sup> Halle, 1869.

<sup>2</sup> *Arch. f. Ohrenheilk.*, Bd. xxi., p. 221.

<sup>3</sup> *Münchener med. Wochenschr.*, No. 49, 1884.

of that portion of the canalis Fallopiæ running through the tympanum, this canal being found quite empty as far as the probe reached. (I hope to give a complete report of the post-mortem in a later article.)

In the fifth case a discharge had existed for three years after scarlet-fever, with proliferation of the tympanic cavity and total destruction of the *Mt.* The facial paralysis has persisted permanently, accompanied with continuous fibrillar twitchings throughout the entire muscular distribution. The affected ear hears the low voice at 10 cm.

In Case 6, bilateral suppuration of middle ear had existed since childhood. Three days after the appearance of facial paralysis, the ear canal of the same side was filled with a large polypus, the removal of which was followed by considerable pain during the next few days following. The loud voice not heard with certainty with this ear. I did not see the patient again.

In Cases 7 and 8, acute exacerbations of suppuration with perforation of the membrana flacc. Shrapnelli had happened. Paresis and paralysis in both of these cases existed for a short time only, with complete recovery.

The ninth case is the only one where there is a probability of the paralysis having been caused by simple acute middle-ear suppuration. The five-year-old boy had had measles three weeks before, with appearance of R. facial paresis a week after recovery. Upon examination: R., otitis med. purulent. acuta; L., otit. med. catarrh. acuta; H D—R.,  $\frac{3}{4}$  metres; L., low voice,  $1\frac{1}{2}$  metres. In the majority of the cases, the pus was extremely foetid.

I do not remember to have seen paralysis or paresis in cases of simple, non-purulent acute middle-ear catarrh. Among the cases of facial paralysis with middle-ear affection, tabulated by Tillmanns, are also present a number of caries, phthisis, etc., the long duration of suppuration in some of them indicating extensive ravages. The great capacity of resistance to destructive influences, shown by the facial nerve, is also verified by the post-mortem observations of Voltolini,<sup>1</sup> Gruber,<sup>2</sup> and Kessler,<sup>3</sup> where, notwithstanding the nerve lay free, owing to destruction of its

<sup>1</sup> *Virchow's Arch.*, Bd. xviii., p. 45, and Bd. xxxi., p. 219.

<sup>2</sup> Text-book, p. 540.

<sup>3</sup> *Arch. f. Ohrenheilk.*, Bd. xviii., p. 26.

canal, no disturbance of its function was noticeable during life.

*In every case of facial paralysis accompanying long-continued suppuration of the middle ear, we are therefore justified in excluding simple superficial suppuration, and in assuming the existence of extensive destruction of the bone, in most instances of the labyrinth.*

*Regenerative Capacity of the Facial Nerve.*

Highly interesting deductions result from several of the histories given in the preceding pages, as to the regenerative capacity of the facial nerve. There is hardly another physiological fact that has been so clearly proven by numerous anatomical, histological, and experimental physiological researches, as well as by clinical observation, as the capacity for regeneration of nerve tissue after solution of continuity,—so much so that he who wishes to penetrate further into the depths of this question, is almost frightened by the mountains of literature that confront him. The functional results of nerve division at least rest upon a firm basis, most observers being agreed that simple division, or loss of substance, is followed by regeneration in the course of weeks or months, according to the conditions present, and provided the loss of substance does not exceed certain limits; also that the duration of this process is longer with the larger nerves than with smaller ones. The extraordinary power of regeneration of nerve tissue has also been shown by a series of other experiments, and also by surgical observations, as, for instance, the healing together of two entirely different nerves, or the successful transplantation of a piece of another nerve in the breach caused by the loss of substance, as where a piece of the sciatic of the rabbit was successfully transplanted in the course of the same nerve in the hen. H. Tillmanns, in his recent work “*Ueber die Operative Behandlung von Substanz-verlusten an peripheren Nerven*,”<sup>1</sup> tabulates a series of these remarkable results, with supplementary surgical observations by Notta, Langenbeck, and Hüber, as well as Sapolini, in which, in

<sup>1</sup> *Arch. f. klin. Chirurgie*, von Langenbeck, Bd. xxxv., Heft 4, page 923.

spite of a traumatic breach of continuity with substance loss of the brachial plexus and radial nerve, amounting to from 5 to 7 *cm*, complete restoration of function finally followed. Basing our supposition upon these observations, we may well conclude that the regenerative capacity of peripheral nerves is almost unlimited. There is, however, not so much unity as regards the histological aspect, and almost every possible theory finds a representative.

Returning to our consideration of facial paralysis in labyrinth necrosis, we find several cases among the forty-six tabulated, where partial or total restoration of the function of the facial, in spite of its division, is not to be doubted. In the six cases in which the facial paralysis was partially recovered from, the sequestrum included, in one case, the whole of the petrous bone, the external osseous ear-canal and a part of the mastoid process (Case 33); in another, a part of the pars petrosa, with the semicircular canals and a part of the mastoid process (Case 34); still another embraced the whole of the labyrinth (Case 40); while the fifth showed a part of the vestibule together with the semicircular canals (Case 17).

By far the most remarkable of all, however, was No. 5 of my own cases (Stirnweiss), where the facialis function was completely intact in spite of the fact that the canalis Fallopiæ in its entire length was included in the sequestrum exfoliated six years before. Unfortunately, the not very intelligent patient is unable to say whether facial paralysis had existed or not. She does not remember that a peculiar appearance of her face was ever remarked by herself or her relatives. A single glance at the accompanying plate depicting the sequestrum can, however, hardly fail to convince us that this could not possibly have been absent. [See Fig. IV., *a*. and *b*.] If the long canal had only been partially disturbed by the suppuration, so as to represent a semicircular groove or channel, the gradual passage of the sequestrum might possibly have occurred without causing a solution of continuity. The facialis-canal, however, as seen in the sequestrum, is completely preserved as such, in its entire integrity, extending from its entrance into the internal

meatus to the middle of the fenestra ovalis, a semicircular groove such as before mentioned being only seen at the vertical portion of the canal after its second bend. A softening and subsequent tearing of the nerve, more probably, however, extensive destruction of it, must undoubtedly have taken place. The fact that the patient did not notice the facial paralysis, would lead us to think that exfoliation took place at an early age, the sequestrum, remaining in the roomy cloaca for years until it finally made its appearance in the auditory canal. Judging from the result of this case we may expect, under especially favorable circumstances, complete restoration, not only in simple division, but also where there is a considerable loss of the substance, of the facial nerve. The favorable conditions above referred to are, in the first place, the closest adaptation possible of central and peripheral ends of the nerve; next, owing to the irregular, crooked, S-shaped form of the canal, the more the canal loses in length the easier is the adaptation of the free ends of the nerve floating in the tympanal cavity, and the greater are the chances for compensation of the loss of substance by means of simple extension of the nerve. According to Tillmanns, it is most important to prevent the interposition of connective tissue between the free ends. He also calls attention to the fact that Vulpian and Philipeaux assert that in nerve transplantation the foreign nerve matter merely acts as a guide or conductor for the new-formed nerve fibres. This theory is supported by Vaulair's experiment, mentioned by the same author, where a piece 3 *cm* long was cut out of the sciatic nerve of a dog, and the nerve stumps then sewed to both ends of a decalcified bone cylinder 4 *cm* in length. At the end of four months the nerve was extirpated, and the loss of substance was found replaced by new nerve fibres. The conditions present in the tympanum may be compared, to a certain extent, with Vaulair's experimental arrangement. The nerve, with more or less implication of its substance, rests upon the granulations springing from the gap in the petrous bone, or is partially surrounded by the growth of the same. As soon as exfoliation of the sequestrum takes

place, it has been observed that rapid retrogression obtains of the proliferous growth in the tympanum. The nerve stumps, therefore, find themselves lying upon a cushion of granulations in a sort of cavity formed for their passage, and there is nothing to prevent their union, unless the direction of their ends is totally different. It seems to me that this is therapeutically not without importance. Of course it is not possible to sew the ends together in the tympanum, for this would indeed be ideal surgery. We might, however, in some cases succeed in recognizing extreme dislocation of the ends of the nerve, and correct it by changing their position. Further than this, could we but divine the points at which the nerve substance was missing, it would, of course, be important to remove obstructing granulations by means of the snare. Cases might possibly fall into our hands in which all this were technically feasible; I have therefore adverted to this possibility, that it may be taken advantage of, should such an opportunity present itself.

*Physiological Deductions from the Regenerative Capacity of the Facial Nerve.*

The possibility of complete reëstablishment of function of the whole muscular distribution of the divided facial nerve, as verified by the cases cited, seems to me physiologically important as regards the question of a more exact localization in the cerebral cortex. The muscular distribution of the facialis is scattered over a pretty considerable surface, while, on the other hand, its motor centres in the cortical substance are found in different parts of the brain, as is shown in central paralysis, which mostly affects the lower branches of the nerve, leaving the orbital region unmolested. The following interesting question hence presents itself: How is it possible to so establish a complete connection between a so widely scattered peripheral distribution and the equally well dispersed motor centres appertaining to it that the different muscle-groups are once more controlled by their appropriate centres acting under the influence of the will, in spite of a preëxisting extensive interruption of the nerve trunk? Even with the most complete

coaptation possible of the severed ends, it is hardly conceivable that the axis-cylinders would meet each other so exactly, or, following the nerve and its ramifications, would so reach its special muscular region, as to reëstablish precisely the primitive relation existing between centre and peripheral distribution. It would, for instance, be quite possible for the central part destined to communicate with the upper facial region, to connect with fibres to the lower part of the face, and *vice versa*. This is exactly what happened in one of my own cases (No. 2, Rieger), who had remained a month and a half under my treatment with unchanged facial paralysis. When I saw her again, two years after extraction of the cochlea, the paralysis had partially disappeared, so much so that, with the features at rest, no trace of the former affection was perceptible. In the meantime, however, involuntary twitchings of the different muscle-groups, repeating themselves at frequent intervals, had become noticeable. The patient can move the corner of the mouth strongly in the lateral or upward direction, *not, however, when he is told to do so, but when he is asked to shut his eye*. When he tries to shut his eye the orbicularis oculi remains immovable, while the muscles of the angle of the mouth act powerfully. This observation, in my opinion, proves conclusively that a connection had taken place between the centre for the orbicularis palpeb. and the peripheral branches supplying the corner of the mouth. In spite of this, we do not consider complete restitution of the facialis function impossible in this case, in the course of years, as happened in the case of the woman Stirnweiss. As the whole of the canalis Fallopiæ was exfoliated in the latter case, perfect coaptation is not conceivable, and hence there is nothing left us but the supposition of a gradual exchange of function between the implicated centres of the cortical substance, and also that the impulses of the mind start from other than their original locations.

The two cases of Rieger and Stirnweiss may perhaps be regarded as different stages of the same process of regeneration, which only reaches its completion with the lapse of time.



*Condition of the Chorda Tympani and N. Petrosus Superficialis Major.*

I shall give these only a passing consideration, referring the reader to the histories of the cases for more minute information. In one of the cases observed by myself I did not test the chorda-function (see history, Case 1). In another, owing to the youth of the patient, it was not to be obtained (Case 4). In my case No. 2 (Rieger) the patient's statements were so uncertain that I could arrive at no definite result (the test was undertaken at the time when the regeneration had already commenced). In another case (see history, No. 3, Blaim), complete anæsthesia of the chorda existed, together with total facial paralysis. In Stirnweiss' case (see history, No. 5) the function of both chorda and facialis was re-established after years, though both had been interrupted at first. Implication of the chorda is only positively reported twice (Bibliography, 5 and 25) by the other observers. As the loss of its function is usually not noticed by the patient himself, testing of the same seems only to have been undertaken exceptionally.

As the chorda not only accompanies the facialis for the whole of its path through the temporal bone (if we agree with Sapolini's observations, lately confirmed by Schulte<sup>1</sup>), but also retraverses the tympanic cavity by a not much shorter way, it is divided in all cases in which the elimination and passage of the sequestrum leads to solution of continuity of the facialis. It is, in addition to this, in its isolated passage across the tympanum frequently exposed to the influence of suppuration, granulation, and especially to direct violence from the passage of the sequestrum through the middle-ear space. It is hence quite reasonable to suppose that the chorda is more often injured than the facial nerve in cases of labyrinth necrosis. If I may be permitted to draw conclusions from the small number of cases observed by me, I think the regenerative capacity of the chorda quite analogous to that of the N. facialis, keeping pace with the same. Implication of the N. petr.

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<sup>1</sup> *Zeitschr. f. Ohrenheilk.*, Bd. xv., page 67.

sup. major—namely, drawing of the uvula toward the healthy side—is mentioned only three times by otologists (Bibl., 25, 35, and 39). In my own observations in the two cases of total permanent paralysis, it remained unaffected. As this nerve only accompanies the facialis as far as the very first part of the canalis Fallop., which is least in danger as compared to the rest of the canal, its non-implication is anatomically quite comprehensible.

Case 4 deserves short mention (see history, my own cases), owing to the deviation of the tongue when stretched forth towards the paralyzed side, as ordinarily this is not seen in facial paralysis. An explanation of this is perhaps given in the supply of the M. stylohyoideus by a branch from the N. facialis, with perhaps an abnormal deviation in the direction of contraction of the muscle itself. The lack of symmetry in the development of the sides of the tongue, towards the point, noticed in Stirnweiss' case is inexplicable to me, the right half of the tongue corresponding to the paralysis showing a gradual diminution toward its point. Although the chorda proved to be perfectly intact in after years, its continuity, as well as that of the facialis, must have been interrupted for a long time. Whether a permanent degeneration of trophic fibres is also here to be accepted, is a problem I am not able to solve.

#### *Extent of the Destructive Process of the Bone.*

This subject has already been touched upon in the chapter on facial paralysis; there only remains, therefore, the somewhat more exact consideration of that region of the temporal bone which is most often the seat of the necrotic process—namely, the pars mastoidea. The same was implicated in twenty-two of the cases resulting in cure, and in five of the nine with fatal issue, that is in 58.7 % of all the cases, and gave partial indication for operative procedures.

*In the 22 cases ending in recovery* 7 showed simple tenderness on pressure (Bibl., 7, 9, 12, 13, 35, 39, 44), 8 abscess behind ear, with spontaneous formation of fistulous opening (Bibl., 5, 14, 16, 19, 33, 34, 41, 46), 2 (Bibl., 24 and 29) in which Wilde's incision was performed, and 5 in which per-

foration of the mastoid process, or artificial enlargement of an existing fistulous opening, was thought necessary (Bibl., 17, 26, 30, 40 and 45).

The five fatal cases showed *twice* (Bibl., 37 and 38) swelling and mastoid tenderness, *once* (Bibl., 19) spontaneous perforation of the external wall with passage of the sequestrum, and *twice* (Bibl., 28, 31) enlargement of fistulæ, and in the latter case, eight years before, scooping out of the mastoid process. Simple mastoid tenderness and swelling is much more significant when complicating a chronic otorrhœa of many years' standing, than when noted in the course of an otitis med. pur. acuta where it often disappears as rapidly as it develops. An example of the diagnostic worth of this symptom is offered in Case 38, where, at the post-mortem, thrombo-phlebitis of the bulbus ven. jugularis was found. Opportunity was hence given in the accompanying bibliography for the consideration of this partially subjective phenomenon. I would like further to call attention to the presence of cholesteatomatous masses in the coalescing cavities within the temporal bone, in two of my five cases. In only one of the other cases was this observed and the removal of the masses by artificial means noted. (Schwartz.) I am convinced that these masses are more frequent in bony necrosis than our statistics would lead us to suspect, for on the one hand they are found very frequently at the post-mortem in subjects where, as in so many cases of labyrinth necrosis, the suppuration has been going on for years (perhaps they are a factor in the origin of the necrosis itself). On the other hand, after exfoliation of the sequestrum the healing process in the resulting cavity often manifests itself by an epidermoidal metamorphosis which prepares the ground for the collection and retention of cholesteatomatous masses, as exemplified in Frau Stirnweiss' case.

#### *Prognosis and Sequelæ.*

As already repeatedly mentioned 19.6 % of 46 cases resulted in death (nine cases). Omitting the two phthisical patients, one of whom (Bibl., 19) died from his constitutional disease, while death in the other (Bibl., 37) was the result of extension of the destructive process to the base

of the brain, reduces the number of deaths to 7, or 15.2 %. In the majority of these cases death followed implication of the neighboring meningeal and cerebral regions, extension of the suppurative process taking place from the posterior surface of the pyramid, corresponding to the position of porus acust. int. The cerebellum was most frequently involved. Post-mortem showed cerebellar abscess in Cases 6, 9, and 28. In the case of phthisis (Bibl., 39) a blackish softening was found at the base of the middle lobe, which had resulted from perforation of the anterior surface of the pyramid. One case (Bibl., 31) showed lepto-meningitis, while in Case 6 death was caused by simple inflammation of the brain. In Case 10 delirium was noted before death, and finally in Case 38 septic phlebitis of the bulbus ven. jug. with pyæmia was demonstrated. In the case of fresh cerebellar abscess (Bibl., 28) there were found traces of old phlebitis and obliteration of the transverse sinus. The terminations of the 37 cases without fatal issue were as follows: In 29 cases the sequestrum was removed from the auditory canal, while in 7 cases it was extracted through fistulæ in the pars mastoid., previous artificial widening of the same being necessary in some of the cases. In the remaining case the sequestrum, according to Schwartze, passed through the tube. In 18 of the cured cases the discharge discontinued a few weeks or months after removal of the sequestrum, its permanent disappearance being verified from time to time subsequently. In 5 cases the otorrhœa persisted but was less copious. In one case constriction, and in another atresia of the bony meatus was noticed after loss of the posterior wall of the ear canal. In the first case (Bibl., 38) the discharge was insignificant, while in the latter (Bibl., 45) it had already ceased before the obliteration ensued, and I am hence not apprehensive of future trouble with either of them. Nothing is communicated as to the otorrhœa in the remaining 14 cases.

When we consider the concealed position and dangerous proximity of the suppuration to important parts, together with the therapeutic inaccessibility and long duration of the destructive process, not forgetting the dangers to the constitution at large, and difficulty of elimination of the

sequestrum, the prognosis seems unexpectedly good even as far as complete cure is concerned, as has already been stated by earlier authors. As already mentioned, there is also a very strong possibility of complete restoration of the function of the divided N. facialis even where an extensive loss of substance exists.

### *Treatment.*

The therapeutic indications may be summed up in a few words, the treatment being about the same as in necrosis of the temporal bone. The most important point is the removal of the luxuriant proliferations obstructing the passage of the sequestrum through the tympanum and ear canal. The sequestrum is surrounded by granulations on all sides, and it is hence our duty to support the tendency to their growth behind it, thus constituting a *vis a tergo*, while we remove the granulations and polypi accumulating in front of it as completely as possible, thus allowing the pressure of the granulations from behind to exert its full influence. The most appropriate instrument for the removal of these proliferations is Wilde's snare. After removal of the sequestrum, further involution is favored by the introduction of alcohol by Politzer's method. Strict antisepsis, as in all suppurative processes of the middle ear, is absolutely necessary. In cases where there is no implication of the mastoid bone, and where the sequestrum is supposably small enough to admit of its passage through the auditory canal, no other therapeutic measures are necessary than those above indicated. In order to fulfil the last-named indication I have used boracic acid, and have been convinced by its efficacy in these severe cases, that the objections to its use (*i. e.*, its causing retention of the secretion), as advocated by Schwartze and some of his pupils, are entirely without foundation. According to my experience, extending over a period of eight years, its use has always been followed by favorable and satisfactory results, so much so that I see no reason to modify my statements made in 1870 in Band xv. of the *Arch. für Ohrenheilkunde*, and in the *Aertzliches Intelligenzblatt*, 1881, No. 26, as to its therapeutic value. I have also confirmed my opinion of the unreasonableness of these objections, by a series of

physiological experiments in which I tested the capacity of absorption of powdered boracic acid for fluids, outside of the body, before as well as after saturation and drying out of the powder, with purulent secretion, which, enclosed in a glass tube covered with a perforated membrane, was exposed to the influence of fluids.

More thorough measures are necessary when the mastoid process is implicated. As soon as elevation of the periosteum exists, or fistulæ show themselves, an opening into the antrum should be made in the former case, or enlargement of the existing fistulous openings in the latter, with removal of the sequestrum. If the sequestrum is too large to admit of its removal in this way, excision of the posterior wall of the osseous ear-canal is indicated. This part of the auditory canal is not infrequently found to be also in a necrotic condition. Another indication for opening the antrum of the mastoid bone is given in such chronic cases where simple mastoid tenderness does not disappear after long-continued antiseptic treatment. After-treatment consists in the primary introduction of a rubber drainage tube, subsequently substituting one of lead, and the frequent washing out with a 1 % solution of carbolic acid with an iodoform bandage. Granulations in the tympanum and ear canal are to be carefully snared off, while the wound and antrum are to be scooped out with the sharp curette when proliferous growths are remarked therein.

*Explanation of the Heliotype plates.*

Fig. I. *a* and *b*, lower turn of the cochlea, *a* seen from without, *b* from within; *c* and *d*, two more small fragments of bone, the first of which is recognized as belonging to the cochlea. (See history of case No. 2, Rieger.)

Fig. II. Lower and middle turns of the cochlea, *a* seen from without, *b* from within. (See history No. 3.)

Fig. III. Lower and middle turn of the cochlea, with a large part of the vestibule and the porus acust. int., *a* seen from without, *b* from within. (See history No. 4.)

Fig. IV. Sequestrum embracing the whole labyrinth and canalis Fallop., *a* seen from without, *b*, from within. (Case No. 5, Stirnweiss.)

REPORT ON THE PROGRESS OF OTOTOLOGY  
DURING THE FIRST HALF OF THE  
YEAR 1887.

A.—NORMAL AND PATHOLOGICAL ANATOMY, HISTOLOGY, AND PHYSIOLOGY.

BY A. BARTH, OF BERLIN.

Translated by Dr. MAX TOEPLITZ, of New York.

I.—ANATOMY.

a.—HEARING ORGAN.

1. Dr. G. GRADENIGO, of Padua. The embryonic rudiment of the middle ear and the morphological significance of the ossicles. With five plates. (From Prof. SCHENK's laboratory in Vienna.) *Wiener med. Jahrb.*, 1887, p. 61. Reprint.

2. Dr. W. KIESSELBACH, of Erlangen. Contribution to the histology of aural polypi. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 4. Reprint.

3. Dr. HERMANN BULLE, Cuxhaven. Contributions to the anatomy of the ear. With one plate. (From the Anatomical Institute at Rostock.) *Arch. f. mikroskop. Anat.*, vol. xxix., p. 237.

4. Dr. KIESSELBACH, of Erlangen. Saw-section for the opening the entire facial canal. *Monatsschr. f. Ohrenheilk.*, etc., 1887, p. 33.

5. G. SCHWALBE. Contributions to the knowledge of the circulation in the cochlea. With one plate. Reprint from *Contributions to Physiology*; dedicated to Carl Ludwig by his pupils. Published by Vogel, Leipsic.

6. Dr. JULIUS WALDSCHMIDT. Contributions to the anatomy of the brain of deaf-mutes. With one plate. (From the Anatom. Instit. of the University of Freiburg.) *Allgem. Zeitschr. f. Psych.*, vol. xliii., p. 373.

7. Dr. v. MONAKOW. On the origin and the central course of the acoustic nerve. Lecture delivered November 11, 1886. *Correspondenzbl. f. Schweizer Aertze*, 1887, No. 5. (Revised by MONAKOW in the *Neurol. Centralbl.*, 1887, p. 201.)

8. Dr. L. EDINGER, of Frankfort-a.-M. Comparative embryological studies of the anatomy of the brain and of the connection of the sensory nerves with the intermediary brain. With five drawings. *Anatom. Anzeiger*, 1887, No. 6. Reprint.

9. Prof. W. BECHTEREW, of Kasan. On the question of the origin of the acoustic nerve and on the physiological significance of the N. vestibularis. *Neurolog. Centralbl.*, 1887, p. 193.

1. On account of the neglect with which the anatomy of the middle ear has been treated when compared to the care awarded to the inner ear, GRADENIGO has devoted his time to these studies, for which every one who takes interest in the anatomy of the ear will be grateful to him. It is, of course, impossible to dwell here upon the details of the examinations and results attained by the author, who has also made careful use of the literature. We highly recommend the paper to the thorough study of our readers, though we can draw attention only to a few points contained in it.

The hammer and anvil may be considered as derivatives from the first pharyngeal arch. The stapes of man and of the higher developed mammals arises from two distinct morphological elements, namely, the stapedia ring from the second pharyngeal arch and the stapedia lamina from the labyrinthian capsule. The lower jaw, the squamous bone, the tympanic ring, and the processus gracilis mallei may be considered as cover-bones of the mandibular cartilage. The first phase of development represents in a measure a regressive process; in the second phase, as soon as the definite forms of the skeleton parts have been approximately reached, the tubo-tympanic space begins to extend. The tympanic cavity first extends around the handle of the malleus and the reflected part of the musc. tensor, then it is prolonged backward along the future membr. tymp., and reaches the posterior margin of the tympanic ring. The mesoblastic tissue around the long process of the anvil, around the stapes, and near both labyrinthian windows disappears last.



2. KIESSELBACH divides the aural polypi into : (1) round-cell polypi (granulation tumors) ; (2) mucous polypi (fibromata with areolar structure and mucinous intercellular substance) ; (3) myxomata ; and (4) fibromata. He has seen a polypus which originated at the transition between the auditory meatus and the middle ear, and was covered with cylindrical epithelium and smooth epidermis. In two polypi he found cysts covered with the most different forms of epithelium varying from the pavement to the ciliated, which latter consisted of several layers.

3. The examined material consisted of petrous bones of man—adults and foetus,—of rats, rabbits, guinea-pigs, and cats. The paper is divided into four parts : (1) upon form, (2) upon epithelium, (3) upon glands of the tympanic cavity, and (4) upon the gland-like appendices of the sacculus. As nothing important can be said about the remarks upon the form, we proceed immediately to the second point. The ciliated epithelium of the Eustachian tube extends along the external wall and along the lateral part of the upper wall to the margin of the membrana tympani ; the inner and lower wall is covered with pavement epithelium, the membrana tympani itself being covered only with single-layered pavement epithelium, so also the osseous walls in the direction from the centre of the *Mt* backward, but sometimes swells at the latter region to cubic form. The ciliated flat cells must be considered transition forms. This relationship in man is also generally found in animals, but in a more irregular manner. In depressed parts higher, often ciliated epithelium is generally found ; in very prominent places nothing but low epithelium. The two-layered epithelium of former embryonic stages is changed later to ciliated of one layer. Gland-like formations could not be found by the author in the posterior region of the tympanic cavity, but farther in front. After careful consideration of their form they are found not to be glands, but “crypts” of the tympanic cavity. The mucous secretion in the middle ear is not affected by certain glands, but by the entire surface of the mucous membrane. Finally gland-like hollow projections in the sacculus of the embryo are mentioned, which are considered equivalent to the projections in the aquæduct already described by others, but their morphological importance can be only surmised.<sup>1</sup>

4. KESSELBACH describes a section which exposes, in addition

<sup>1</sup> Apparently an extract from the dissertation : “Contributions to the Anatomy of the Ear.” Rostock, 1886. The latter was not at my disposal.—REVIEWER.

to the entire facial canal, and the openings of the accessory canals, the transition to the antrum, the lower part of the vestibule with the foramen ovale and the commencement of the cochlea, as also the point of entrance of the auditory nerve ; the posterior part of the section exposes the situation of the antrum mastoideum, and the lower part of the vestibule with the semicircular canals.

5. SCHWALBE gives a clear description of the arrangement of the blood-vessels in the cochlea of the guinea-pig, which comprises much that is new, many facts which until now were only partially known, and the main points of which will certainly be agreed to by all anatomists. The central canal of the modiolus does not represent a straightly stretched and regular cone, but is turned around its axis, so that the surface is alternately elevated and depressed, the form of the canal thus resembling a screw. Rarefied and thickened spots are thereby formed in the osseous mantle of the modiolus, which are pierced in a distinct alternation by nerves and vessels. Nothing is more striking in an axial section of the cochlea than the spirally turned trunk of the acoustic nerve, which forms the well-known ganglionic enlargement on its course to the lamina spiralis. Always between two exits of nerves there remains between nerve-trunk and osseous (vestibular) wall of the modiolus a space filled with loose connective tissue, the "*tractus spiralis arteriosus*," in which the larger arteries springing from the cochlear artery take their course. The further arrangement of the blood-vessels is minutely described.

6. Having the opportunity of examining two brains of deaf-mutes, the author found in both concordantly a striking rudimentary development of the islands of REIL on the left side, especially of the parts situated frontally. Upon trying to explain these anatomical relations he points to the fact that the centres of speech and hearing do not need to be degenerated, but that a (partial) interruption of conduction suffices to affect the inhibition.

7. The author had previously shown that in ablation of the hearing sphere of the cortex in cats, this centre is shown to be in connection with the corresponding corpus geniculatum internum and the brachium conjunctivum posticum (perhaps also with the corpora quadrigemina posteriora). The removal of a part of the cortex from the right hearing sphere and the excision of the right lower lemniscus from the bigemina posteriora in the region of the exit of the fifth nerve in a cat directly after birth has the following result : Atrophy of the anterior portion of the upper olive

and of its dorsal medullary covering. This atrophy could be traced towards the raphé in a caudal-medial direction, then into the striæ acusticæ of the opposite side, and finally into the acoustic tubercle (here in both upper layers); the posterior root and the anterior nucleus of the acoustic nerve did not seem to be materially implicated. The course of one part of the acoustic nerve, therefore, would be, going from the periphery to the centre: Acoustic tubercle (superficial layers); striæ acusticæ; crossing in the raphé; inferior lemniscus and dorsal medulla of the upper olive; corpus geniculatum internum; hearing sphere. The course of the acoustic nerve is probably on its way to the cerebrum interrupted at least twice by groups of ganglionic cells (corpora quadrigemina posteriora and corpus geniculatum internum), so that one could speak of primary, secondary, and also of tertiary paths of the acoustic.

8. The course of fibres in the central nervous system of the lower vertebrates is almost as much complicated as in man, consequently their examination does not cast much light upon their relations. Pictures which are almost ideally transparent are obtained by combining the study of the development of the medullary sheaths with that of the central nervous system of lower vertebrates. Young slow-worms (*anguis fragilis*), about twenty days old, are well fitted for these examinations. We can easily distinguish therefrom, that fibres descend from both sides of the intermediary brain into the medulla oblongata, turning now here now there inwards, transgressing the raphé, and collecting outward of the crossed posterior longitudinal bundle to a funiculus, which is larger at the fifth nerve, but thinner at the eighth, ninth, and tenth. But each of the nuclei receives a separate tract. The author suggests to call this tract, as being identical with a part of the lemniscus in man, the "central sensory course." The nuclei of the sensory course would be connected in the same manner as the nuclei of the posterior columns by fibræ arcuatæ with higher located centres of the crossed side.

9. BECHTEREW refers to his examinations,<sup>1</sup> and does not agree with EDINGER, that the anterior root of the acoustic nerve arises from the so-called inner nucleus of the acoustic. He desires to have the posterior portion of the "direct sensory cerebellar path" still acknowledged as the ascending root of the acoustic. Also against EDINGER stands the fact that there is no direct connec-

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<sup>1</sup> Cp. THESE ARCHIVES, vol. xv., Nos. 2 and 3, p. 252.

tion between the roots of the peripheral nerves and the cerebellum. The so-called ascending root of the acoustic is undoubtedly a continuation of the second branch of the anterior root, but not a continuation of the posterior columns to the cerebellum. The second part of the paper criticizes the researches of BAGINSKY, who explains the motory disturbances following lesions of the semicircular canals by simultaneous injuries to the cerebellum.

*b.*—NASO-PHARYNGEAL CAVITY.

1. ROSTANECKI, CASIMIR VON. The pharyngeal ostium of the Eustachian tube and its relation to the naso-pharyngeal cavity. With two plates. (From the Anat. Inst. at Berlin.) *Arch. f. mikrosk. Anat.*, vol. xxix., p. 539. Reprint.

2. ZUCKERKANDL, E. On the centre of smell. A comparative anatomical study. (Stuttgart, 1887, Enke.) From a review by S. Freud in the *Monatsschr. f. Ohrenheilk.*, etc., 1887, p. 132.

1. ROSTANECKI, after reviewing the existing literature and comparing it carefully with his own thorough investigations, gives, in a measure, a monograph on the pharyngeal ostium of the Eustachian tube and the naso-pharyngeal cavity. He explains with skill some abnormal cases, and thus simplifies their comprehension. It would serve no purpose to review here portions of the paper, as it is necessary to look at the drawings in order to understand the complicated and varied relations, and it is often desirable to inspect the specimens. We refer herewith urgently to the original. We draw the attention of the physicians to the particular point observed by Rostanecki against other modern authors—that the pharyngeal tonsil may extend to the tuberosity of the tube, and even into its ostium.

2. The olfactory nerve in a number of mammals shows a striking tendency to a retrogressive state. The parts of the cerebrum partaking in this retrogression must thereby be considered as belonging to the "centre of smell." The parts of the cerebrum having the relations to the olfactory in the manner mentioned, are the portions of the medial surface which form the inner margin of the primitive cerebral vesicle, hence surround the fornix, which they perforate later, and complete the ring by joining the olfactory tract and its roots—in man the region of the gyrus fornicatus and the parts situated underneath. The frontal extremities of the lobus corporis callosi and of the lobus hippocampi in the "anosmatic" animals are atrophic; the atrophy of the latter is extremely devel-

oped in dolphins, in which the olfactory nerve is entirely absent. Inwardly from the gyrus fornicatus the lobus limbicus in animals is a small marginal tract, called by ZUCKERKANDL the gyrus marginalis, which is stunted in man to the greatest extent. The anterior commissure seems also to belong to the olfactory region of the cerebrum. MEYNERT described the anterior commissure as a chiasma of the olfactory nerve. FREUD considers this a part of the centre of smell, as the olfactory tract is seen in the human embryo to come out of the anterior portions of the fissures of SYLVIVS.

## II.—PHYSIOLOGY AND PHYSICS OF THE HEARING ORGANS.

1. DELAGE, M. YVES. Sur une fonction nouvelle des otocystes chez les invertébrés. *Compt. rend.*, vol. ciii., p. 798.

2. VIGUIER, M. C. Sur les fonctions des canaux sémicirculaires. (Extrait.) *Ibid.*, vol. civ., p. 686.

3. Prof. W. RUTHERFORD, F.R.S. A new theory of hearing. *Fourn. of Anat. and Physiol.*, vol. xxi., p. 166.

4. KOENIG, A. On the testing of acuteness of hearing by sounding-out tuning-forks. *Verh. d. physiol. Gesellsch.*, 1887, Nos. 11 and 12.

5. Dr. H. DENNERT (Berlin). Acoustic physiological examinations with demonstrations. (Lecture delivered September 22, 1886, in the otological section of the meeting of naturalists in Berlin.) *Arch. f. Ohrenheilk.*, vol. xxiv., p. 171.

6. Dr. W. KIESSELBACH. On tinnitus aurium. *Sitzungsberichte d. physic-med. Societät in Erlangen*, No. 18, p. 95.

7. F. MELDE (Marburg). Acoustic investigations. Third series. *Wiedemann's Annalen d. Physik und Chemie*, vol. xxx., No. 1, p. 161.

8. MERCADIER, M. E. Sur la théorie du téléphone : mono-téléphone ou résonateur électromagnétique, Presented by M. Corum. *Compt. rend.*, vol. civ., p. 970.

9. MERCADIER, E. On two new kinds of radiophone. *Journ. d. Phys.*, 1886 (second series), vol. v., p. 215. (From a review in the *Naturwiss. Rundschau*, 1885, p. 327.)

10. Dr. NOWITZKY (Kasan). On the physiological qualities of the fibres of the chorda tympani in man. (From the aural department of the military hospital at Kasan.) *Medizinskoje obozrenije*, 1886, No. 11, June 15.

1. The author has experimented with mollusks and higher crustacea. If the eyes are destroyed, the movements are retarded in most cases, but otherwise hardly disturbed; but after an injury to the otocysts the most marked disturbances of movement develop, especially when the animals attempt to get up. Hence he infers that the otocysts have the same physiological significance as the labyrinth in higher animals.

2. A short communication against YVES DELAGE referring to VIGUIER's paper, which has treated the same subject in the *Revue philosophique* and in the *Revue internationale des sciences*, 1882.

3. The author compares the process of hearing in the ear with the telephone, and would like, therefore, to call his theory the "telephone theory." He supposes that the little hairs of all cells of the cochlea follow the vibrations of the memb. tymp., which are transmitted by means of the cells through the nerves to the brain. It is here, the first time, that the mechanical, *i. e.* in a certain sense the electrical, irritation is changed into the specific sensation; here the perceived impressions are first dissolved into isolated tones, harmonies, and discords.

5. The author has promised to publish the tenor of the lecture in these ARCHIVES, with the addition of new facts. The principal features of this paper are as follows: 1. If we call the time, during which a tuning-fork after being struck can still be heard by a normal ear by bone- or by air-conduction, the sounding-time of the bone- or the air-conduction, then we may characterize the pathologically increased or lowered amount of the lower irritation threshold of an ear, by expressing the sounding-time of this ear in the unit of the normal sounding-time. 2. In tuning-forks of the same pitch and of the same initial amplitude, this determination is independent of the logarithmical decrement of the vibrations of the tuning-fork.

6. KIESSELBACH asserts that in healthy and sick persons the sound perceived in tinnitus and the ringing produced by the galvanic current is an objective sound. The sound produced by the circulation of the blood is to be regarded as source of the noise; we do not hear it under normal conditions, because we are accustomed to the sensation, but we perceive it as soon as the objective noise has increased or changed, or the sensitiveness of the acoustic nerve is intensified. The invariable perception of a certain sound is explained by the resonance of the tympanic cavities. The doctrine of the specific energy is to be confined to the follow-

ing limits: An irritation of the acoustic nerve, in the specific sense, is effected only by repeated influences of vibrations of a certain nature, transferred from the outside to the sound-perceiving apparatus. All other influences are said only to increase the irritability. Possibly this view may not wholly agree with the physiological facts.—REV.

7. Although the researches were of a purely physical nature, I deem it advisable to mention them, because they permit several conclusions as to the vibratory processes in the membr. tymp. and in the internal ear. We deal with vibrations of rotatory planes, namely, of bells, circular cylinders, and funnels. Further researches are related, where a body that is susceptible of vibratory motions is inserted into another, and are demonstrated, under what circumstances one causes the other to follow the vibrations or to deaden them. For further details, see the original.

8. The telephonic tympanum may vibrate in two ways: either that it vibrates mainly transversely, namely, in its own key, by supporting it in a given way ("monotelephon" or "electromagnetic resounder"), or so that it reflects the vibrations of sound with the utmost possible accuracy ("Pantelephon"). The monotelephone can be easily changed into a pantelephone by deadening the vibrations of its own key.

9. There are two methods of producing impressions of hearing by intermittent radiation; the conversion of rays into sound is either direct or indirect. We distinguish three separate kinds of direct transmission—thermophones, photophones, and aktinophones. Up to the present, no example of the last is known. The indirect radiophones convert the energy of radiation into energy of sound by intermediary transformations. BELL's apparatus is the only one which has been heretofore known as such, and which has derived from its action the more accurate name, photoelectrophone. MERCADIER has constructed two new kinds of indirect radiophones, the principle of which is based upon the conversion of the energy of the rays of heat. As auxiliary apparatus, the telephone and the mikrophone are used. The pitch of the notes depends upon the interruptions of radiation. According to its action, one is called "Thermoelectrophone" and the other "Thermomagnetophone."

10. The author has examined whether the chorda tympani contains all gustatory nerves for the anterior two-thirds of the tongue, or whether a part of them is supplied by the nervus lingualis tri-

gemi; furthermore, whether the chorda contains fibres for sensations of taste and pain. He arrived at the latter question, because in pathological cases irritation (with the probe, syringe, and brush—URBANTSCHITSCH, TRÖLTSCH) produced only in exceptional cases specific sensation of taste, but with far more regularity, pain, tickling, and burning. The material for his examinations consisted of two cases of otitis externa (et media) gangrænosa dextra in two soldiers, probably caused by attempts at self-mutilation. Both had facial paralysis of the right side, the velum palati not being involved. The soldiers were subjected to the examinations mentioned above, and also the secretory functions of the chorda in the sublingual and submaxillary glands were tested to make the examinations complete. The researches were made with all the necessary precautions, and in sufficient number, as can be seen from the original. As regards the function of taste, *e. g.*, each of the four gustatory fluids (concentrated solution of salt, solut. chinin. muriat., 1.3 : 30.0, syrup with aqua aa, acid tartar., 2.0 : 30.0) were tried sixty times on each patient, and counterexperiments were made with aqua destill.; at the time being only two kinds of taste, and that only on two places of the tongue, were tested.

The results of the examination on the alteration of taste are as follows: The anterior two-thirds of the back of the tongue were on both sides insensitive to all four impressions of taste as mentioned; at the point and at the lateral margins of the anterior two-thirds, each fluid was exactly perceived on the left side, but the solutions of salt and quinine more slowly than the two others. On the right side entire absence of any kind of sensation of taste was noticed; at the base of the tongue all four fluids were accurately distinguished.

He concludes: There are people, whose chorda contains three kinds of fibres: gustatory, sensory, and secretory.

## B.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, BERLIN, AND ED. SCHULTE, MILAN.

Translated by Dr. MAX TOEPLITZ, New York.

## I.—GENERAL LITERATURE.

1. Prof. DE ROSSI. Saggi di clinica chirurgica otojatrìca, laryngojatrìca, rinojatrìca. *Anno scolastico*, 1885, 1886. Rome, 1887.



2. KIPP, C. J., and RANKIN, WM. Seventh annual report of the Newark Charitable Eye and Ear Infirmary, 1887.
3. MATHEWSON, PROUT, and RUSHMORE. Brooklyn Eye and Ear Infirmary. Report for 1886.
4. MACKAY. Report of cases of diseases of the ear under the care of Dr. KIRK DUNKANSON. *Edinburgh Med. Jour.*, Feb., 1887.
5. BACON, GORHAM. A report of twenty-one cases of traumatic lesion of the ear. *N. Y. Med. Jour.*, May 7, 1887.
6. SEXTON, SAMUEL. Boxing the ears. *Med. Record*, June 11, 1887.
7. SEXTON, SAMUEL. Injury of the ear caused by the blast of a bursting shell, with some remarks on the effects of explosives on the organ of hearing in warfare. *Med. Record*, Feb. 19, 1887.
8. EITELBERG, A., Vienna. Contribution to the differential diagnosis of the diseases of the sound-conducting and sound-perceiving apparatus. *Wiener med. Presse*, 1887, Nos. 10-12.
9. KRETZSCHMANN, F. On carcinoma of the temporal bone. *Arch. f. Ohrenh.*, vol. xxiv., 4.
10. LICHTWITZ. Les anesthésies hystériques des muqueuses et des organes des sens et les zones hystérogènes des muqueuses. Paris, 1887.
1. DE ROSSI's full report embraces a large number of valuable experience in otology, rhinology, and laryngology. In acute inflammations of the middle ear Rossi added to myringotomy an immediate inflation of boric acid, preventing thereby suppuration and effecting a quick cure. Caustic treatment of purulent otitis media with strong solutions of nitrate of silver was given up on account of the pain that it caused and the extension of inflammation to the mastoid process, which sometimes followed. Treatment with boric acid was substituted for it. When retention of secretion is feared from the application of boric acid, boro-glycerine is recommended, which has been found very successful by the author. Sclerosing processes were treated in the usual manner. The bases of polypi were destroyed with the galvano-cautery. Alcohol did not produce any visible effect upon the remains of the polypi. In diseases of the acoustic nerve Rossi obtained excellent results in several cases with injections of pilocarpine. Four hundred and ninety-six patients were treated in one year, 1885-6. The second part of the report deals with the "clinica laryngo-rinojatrica."

2. In the Newark Eye and Ear Infirmary there were treated, in 1886, 1092 ear cases. Of these 56 were of the auricle, 269 of the external auditory canal, 746 of the middle ear, 6 of the inner ear, and 11 unclassified. Of operations, the most important were: paracentesis of the drum-head, 27; section for mastoid abscess, 5; perforation of mastoid cells, 1; removal of necrosed bone from mastoid, 1; polypus from ear, 11.

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3. The ear cases in the Brooklyn Eye and Ear Hospital for 1886 were 1,603 in number. Of the important operations there were of Wilde's incision, 5; polypi, 6; paracentesis of *Mt*, 4.

S. M. B.

4. MACKAY's report embraces 3,725 ear patients treated during four and a half years in Kirk Dunkanson's Infirmary. 33 % of all cases were chronic purulent inflammations of the middle ear; 27.8 % were chronic catarrhal affections, of which 5 % were of syphilitic nature. Mackay also, like Richey and many others, considers ceruminous plugs as indications of a more serious disease of the middle ear.

S.

5. BACON gives more or less full notes of all the cases. Among the important facts to be noted are that in six cases the inflammation of the external canal was caused by the introduction of hair-pins. Injuries in other cases were caused by pins, sticks, ear-scoops, etc. The drum-head was ruptured by a fall in one case, by a blow in one, and by the loud report of a cannon in one. Snow-balls were the causes of injury in two cases. The author is inclined to the belief that in most cases of traumatic rupture of the *Mt* from rarefied or condensed air, the drum-head was weakened through a catarrhal process or a calcareous deposit. The medico-legal aspects of such cases are noted.

S. M. B.

6. SEXTON treats rather extensively of the effect of the too common practice of boxing the ears. The symptoms are nervous shock, pain, deafness, autophony, and numbness, and where there has been a rupture of the *Mt*, the characteristic whistle. The rupture may be single or multiple. The prognosis is, in most instances, favorable. As a point in diagnosis, he thinks that ruptures of the *Mt* from blows are usually on the membrana vibrans, while those from pulling are in the membr. flaccida. As regards treatment, the *laissez-faire* plan is recommended. He suggests, however, in some cases insufflation of boric acid and calendula. The medico-legal aspects of the injury are also considered.

S. M. B.

7. SEXTON gives in this paper, which is very exhaustive in details, the results of an examination of the ears of eight men, who were in the vicinity of an exploding shell. In six of the men there was rupture, in some of them extensive, of the drum-head. In all there was serious impairment of hearing. S. M. B.

8. EITELBERG argues from the supposition that a diseased acoustic nerve tires more readily than a normal one. He sounded a tuning-fork for fifteen to twenty-five minutes in front of the ear, by striking it with the same force each time by means of a certain contrivance. The duration of perception was recorded each time. Experiments were made upon persons with normal hearing and upon fifty patients. In persons with normal hearing the duration of perception after a slight diminution increased so much that it was greater at the termination than at the beginning of the experiment. In affections of the conducting apparatus the same result was obtained, if the duration of perception was greater from the start; if this was not the case, it remained about the same during the entire examination. If, on the other hand, the duration of perception was considerable from the beginning, it remained about stationary, only in affections of the labyrinth. It generally decreased in the latter without rising again to the initial amount.

9. KRETZSCHMANN undertook to depict the clinical and anatomical features of the carcinomata of the temporal bone upon the basis of four cases observed by himself, and twelve cases collected from literature. As regards the etiology, he arrived at the incontrovertible conclusion that a large number of neoplasms develop on the soil of chronic suppuration. As another etiological factor, he emphasizes the habit of many persons of boring in the ear with an instrument. The differential diagnosis between carcinomata and sarcomata is made by the quicker growth of the latter, by the tumor developing in the surroundings of the ear, by the more rapid course taken by the sarcomata, and by the prevalence in children at the ages of the first decennium. As regards treatment, the author pleads for the removal of all masses within reach with the sharp spoon, since thorough removal of the putrid masses makes the state of the patient much more tolerable, even if the duration of life is thereby shortened. Regarding the anatomical and histological details, we refer to the corresponding part of this report. S.

10. LICHTWITZ, in his elaborate monograph, describes the

hysterical anæsthesia of the mucous membranes, and of the organs of sense, upon the basis of numerous personal observations and considerable experience, with careful reference to the literature existing on this subject. We must confine ourselves to the recommendation of the paper to the study of our readers, and to quote only the conclusions referring to the hearing organ. The hearing organ and the membrana tympani were twice anæsthetic on the hemianæsthetic side of the body. In the other cases of hemianæsthesia of the dermal surface, only the cartilaginous part of the external auditory canal was insensitive, whilst the osseous part and the *Mt* remained sensitive. In analgesia of the skin, the external canal and the *Mt* were also analgesic. The Eustachian tube never seemed to be anæsthetic. In these cases complete, or almost complete, deafness was noticed on one side. In two other cases only the perception of whisper was decreased, the air-conduction for the watch and the cranio-tympanic perception being normal. In the sixth patient the hearing was decreased only for the tick of the watch when heard through the air. In two cases there was deafness for very high notes. The cranio-tympanic conduction was completely destroyed in one ear only in cases of complete deafness on one side. It was decreased or unchanged when this was the case with the air-conduction. The different tuning-forks placed upon the vertex were perceived better or only by the normal ear in cases with impairment or anæsthesia of hearing on one side. Rinne's experiment showed always a positive result. There did not exist any relations between the anæsthesia of hearing and that of the skin. No connection was found between the partial and general anæsthesia of the hearing organ. There was no hearing in one ear, of which the external canal and the membrana tympani were sensitive, whilst it was preserved in another, of which these parts were anæsthetic.

## II.—INSTRUMENTS AND METHODS OF EXAMINATION.

11. PRINCE, ARTHUR E. The Politzometer; an instrument to increase facility and precision in the inflation of the middle ear. *Medical News*, 1887, No. 23.

12. SEISS, RALPH W. A new method of treating chronic aural catarrh. *Medical News*, 1887, No. 6.

13. MITCHELL, H. E. A modification of Politzer's air-bag. *Transact. N. Y. State Med. Association for the year 1886-1887*, p. 207.

14. BISHOP, S. S. Novel methods of treating diseases of the middle ear. *Fourn. Amer. Med Assoc.*, June 15, 1887.

15. Dr. KRAUSE, instruments devised by. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 3.

16. KILLIAN, GUSTAV. A new galvano-caustic immersion battery. *Deutsch. med. Wochenschr.*, 1887, No. 15.

11. PRINCE, as a substitute for the swallowing, the "hick, heck, hock," and other means of closing the pharynx during inflation by POLITZER's method, uses a tube attached to a column of mercury, through which the patient blows. The velum hereby closes the naso-pharyngeal cavity, and the muscles of the tube open its entrance. Prince considers this method to be less unpleasant to the patient, more convenient to the physician, and more valuable for diagnosis and prognosis. The amount of displacement of the mercury registered the amount of pressure required to dilate the tubes and inflate the tympanum. The author calls the instrument "*Politzometer*." SWAN M. BURNETT.

12. The new method of SEISS consists in medicating the mouth of the *Eustachian* tube by means of a catheter perforated at its sides near the point. The medicament is thrown into the catheter by means of a syringe. Seiss and C. H. BURNETT have seen the best results from the use of this instrument, by which they have applied for the last year various antiseptics and astringents.

SWAN M. BURNETT.

13. MITCHELL's modification of POLITZER's air-bag consists of an instrument with a smaller bulb and an automatic valve, whereby the air can be forced from it much more quickly, and the expense is reduced to a minimum.

M. TOEPLITZ.

14. The novel methods of BISHOP are perhaps in use by many otologists. The first one consists in exhausting the drum cavity and bringing away its fluid contents by reversing the Valsalvan experiment. The second is to accomplish the same end by introducing the catheter and making suction by means of a syringe. The third, which the reviewer has used for many years, consists in filling the meatus with the desired liquid in cases where the *Mt* is gone or perforated, then sucking the air out by means of the reversed VALSALVA, when the liquid will pass down the tube into the throat.

SWAN M. BURNETT.

15. KRAUSE describes a fixable palate-hook, a curved trocar for opening HIGHMORE's antrum, a trocar à double courant, and a nasal saw, and gives illustrations of them.

S.

16. KILLIAN'S immersion battery, consisting of zinc-carbon plates immersed in chromic-acid solution, is worked by simply placing the foot upon a treadle. The glowing is increased by treading more downward, but ceases when the foot is removed. The author considers his instrument to be of especial advantage, inasmuch as the battery is much preserved by the manner in which it is immersed and by its automatic elevation immediately after the cauterization is finished.<sup>1</sup> S.

### III.—EXTERNAL EAR.

17. Dr. W. KIRCHNER, Würzburg. Contribution to the etiology of furuncle. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 1.

18. STEINHOFF, FRANZ. Observations upon otitis externa crouposa. *Inaug. Dissert.*, Leipzig, 1886.

19. Dr. I. PURJESZ, Budapest. Formation of a bridge of connective tissue in the external ear. *Wien. med. Wochenschr.*, 1887, No. 1.

20. FIELD, GEORGE P. On aural exostosis. *Brit. Med. Jour.*, 1887, No. 1374.

21. STORY, JOHN B. Oxostosis in the auditory meatus. *The Dublin Journal of Medical Science*, January, 1887.

22. JAKINS, PERCY. A case of ear cough. *The Practitioner*, June, 1887.

23. Dr. ZIEM, Dantzig. An amber button in the ear. *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 5.

24. Dr. CHARLES DELSTANCHE, Brussels. "Observations de corps étrangers dans l'oreille. *Annales des maladies de l'oreille*, etc., 1887, No. 2.

25. GURANOWSKI, Warsaw. Contribution to myringoplastic by means of the shell-skin of a hen's egg. *Medycyna*, 1887, Nos. 12, 13, 14.

26. WAGNIER, Lille. Du tympan artificiel. *Revue mens. de laryng.*, etc., 1887, No. 6.

27. HUMMEL. The measurement of the capacity of the external auditory meatus under normal and pathological conditions. *Arch. f. Ohrenheilk.*, vol. xxiv., 4.

17. KIRCHNER succeeded in obtaining from the contents of

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<sup>1</sup> An analogous instrument has been devised by SEILER, and known for a long time in this country (M. T.).

aural furuncles pure cultures of staphylococcus pyogenes on sterilized gelatine. Hence he concludes that the treatment of furuncles, in addition to the incision, must be antiparasitic, and recommends to syringe the meatus with a lukewarm one per cent. solution of sublimate previous to the opening, to dry it with sublimate cotton, and to brush the sublimate solution into the wound by means of a camel's-hair brush after the incision. The author reports, in addition, a case of direct transmission of an aural furuncle from one individual to another by means of a sponge used for cleansing an ear affected by furunculosis. S.

18. STEINHOFF, upon the basis of thirty-five histories of cases of otitis externa crouposa from BEZOLD'S practice, describes the symptoms as follows: In addition to another affection of the ear (diseases of the external ear 19 times, inflammation of the middle ear 11 times), or to spontaneous occurrence (5 times), there existed pulsating pain, considerable diminution of hearing and fullness in the ear, in connection with the formation of fibrinous exudation, which appeared once or twice upon the surface of the membrana tympani, or the walls of the external meatus. The pseudo-membranes are easily removed with syringe or forceps. They are whitish-yellow, partially suffused with blood, and "their gelatinous consistency and the resistance which they offer the needle when teased are so characteristic, that from this condition alone the diagnosis can be made with certainty. The microscopical examination of the removed membranes always showed "a delicate, fine, and at times somewhat grosser network, with often more or less incarcerated, laminated epidermis cells and round cells, which, however, are not equally distributed over the entire specimen." The prognosis is favorable. The treatment consists in the removal of the membranes, drying of the external meatus, and subsequent inflation of powdered boric acid or iodoform.

19. In PURJESZ'S patient, who suffered from otorrhœa for twelve years, an intense swelling of the external meatus developed, which, after its subsidence, left two opposite granulations in contact. A firm bridge of connective tissue arose from these. This was cut and the cut surfaces cauterized with nitrate of silver. A similar case with a membrane of connective tissue already formed was observed and treated in the same manner. Purjesz found only two cases of the same kind in literature.

20. FIELD published in the *British Medical Journal* for 1886, sixteen cases of exostoses of the external auditory meatus, and

continues here with nine more cases of the same kind, in which the lesion existed on one or both sides. Seven of these were operated with drills similar to those used by dentists. To avoid too deep a penetration of the drill a crossbar is attached to the handle. The instruments used are illustrated. One female patient was operated upon with a forceps; on another the operation was considered superfluous, and not performed. Field deems the operation unnecessary if the exostosis does not cause any disturbance or danger, but he considers it urgently indicated if it prevents a discharge of pus.

21. STORY had under treatment a case of exostosis in both external canals. They were situated close to the drum-membranes. The acuteness of hearing was greatly diminished. Story first thoroughly cauterized the skin covering the tumor in the right ear with carbolic acid, then bored a hole into the exostosis with the dental drill, and placed into the hole a negative electrode for the purpose of electrolysis. Several electrical sittings of three minutes' duration took place. Between times cauterizations with potash, lime, and Vienna paste were made. By means of the latter a perforation of the membrana tympani, which soon again healed, was produced, but the hearing improved remarkably and permanently.

The left ear was not operated upon. The author is of the opinion that exostoses of the external meatus should not be operated upon if they do not cause any defect in the hearing, and even not if they destroy the faculty of hearing in only one ear whilst the other retains its hearing power.

22. JAKINS treated a patient who had suffered for four years from a steadily increasing cough, and since that time had been hard of hearing. Finally he grew thin, night sweats set in, and at times he was delirious and could not sleep at night. Jakins found mucous râles in the lungs and plugs in the ear. After removal of the latter the patient slept already the following night, the pulmonary symptoms disappeared, his weight increased, and he was fully capable of following his occupation after three months.<sup>1</sup>

23. ZIEM removed from the external meatus of a patient an amber button of polyhedral form, which measured 2.5 mm in its transverse and 6.5 mm in its greatest diameter. Not succeeding

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<sup>1</sup> A precisely analogous case was communicated to me a number of years ago by ZELLER, the late chief of the lunatic asylum of Winnenthal.—Moos.



in removing it with the syringe in the erect position, the patient was placed upon the side where the foreign body was located, and this time the operation succeeded. S.

24. DELSTANCHE reported several observations on foreign bodies in the ear, which could not be removed with the syringe in the usual manner, but required treatment with instruments. In the first case a piece of a goose-quill had to be removed with the forceps. The second case was a lady who had placed a piece of turnip in the ear on account of a toothache. By injudicious manipulations it was forced to the bottom, whereupon cerebral symptoms and intense swelling of the external meatus ensued. After two dilatations with laminaria, the foreign body could be removed with the forceps. In the same manner a Swedish match, which was wedged into the drum-membrane, was removed. Out of the lobuli of a child two pieces of an ear-ring were removed after incision. A revolver-bullet, which had entered the external meatus and had lain there without causing any symptoms, was removed after ablation of the auricle, whereupon inflammation of the middle ear set in in consequence of an injury to the membrana tympani, which lasted a long time. Cure, with slight hardness of hearing.

25. GURANOWSKI reports eight cases of otit. med. suppurat. chron., of which three existed on one side, and five on both sides. In three cases the myringoplasty, by means of the shell-skin of a hen's egg, was successfully performed. In five cases the myringoplasty was made seven times, twice successfully, four times with uncertain, and once with unfavorable result. The report is preceded by a short history of myringoplasty.

SREBERNY (Warsaw).

26. WAGNIER gives an historical essay on the artificial drum-membrane. He himself prefers GRUBER's application of the artificial drum-membrane, which consists of a small disk, similar to that of TOYNBEE, but without the guiding wire. Wagnier considers YEARSLEY's small cotton pellet less effective. It should only be employed if Gruber's artificial drum-membrane is not tolerated.

27. HUMMEL, at Bezold's request, has determined the capacity of the normal external meatus, the result of which was 1.07 for the right side and 1.05 for the left. The capacity is the same in 66 per cent., and varies in 44 per cent. On the basis of these results the author attempted to determine the extent of cavities

formed pathologically in the petrous bone. From his comparison of the capacity of the external meatus on the healthy side, with the volume of the external meatus and the cavity on the affected side, and the cubic volume of the cavity, external meatus, is shown that the determination of the external meatus is an important means of ascertaining the extent of the existing processes of destruction in the middle ear. S.

*(To be concluded in our next number.)*

## REVIEWS.

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### **A Reference Hand-Book of the Medical Sciences.**

Edited by ALBERT H. BUCK, M.D. Volumes I. to V. William Wood & Co., N. Y. 1885-1887. (To be completed in eight volumes. Sold by subscription only.)

The articles belonging to otology in the first volume of the "Reference Hand-Book of the Medical Sciences" are : "Auditory Canal," the anatomy of which is by Gorham Bacon ; "Its Congenital Defects, Diseases, and Injuries" are treated of by Frank Butler ; and "Foreign Bodies in," by Samuel Theobald. "The Diseases of the Auditory Nerve" are considered in a very exhaustive article of fifteen pages, by C. H. Burnett, in which all affections of the auditory nerve and centres, primary and secondary, are treated of in more or less detail. It constitutes an excellent summary of existing knowledge on the subject. "The Anatomy and Physiology of the Auricle" are given by Gorham Bacon, while "Its Diseases and Malformations" receive treatment at the hands of Samuel Sexton.

The otological papers in Vol. II. are most important. "Deaf-Mutes" are treated of extensively by Profs. Gallaudet and Fay, embracing some most valuable statistics, and "Deafness," by H. N. Spencer. "Ear" is treated of under several heads—"The Anatomy of the Labyrinth," by W. G. Thompson ; "Ear, Development of," by C. S. Minot, in his customary careful and exhaustive manner ; "The Examination of the Ear for Diagnostic Purposes," by Huntington Richards ; while "The General Therapeutics of Aural Affections" is attended to by the editor, Dr. Buck. D. B. St. J. Roosa writes of "Non-Suppurative Inflammations of the Tympanum," while "The Purulent Inflammations" are treated of in an exhaustive and masterly manner by J. Orne

Green. "The Anatomy and Physiology of the Eustachian Tube" are described by Gorham Bacon.

Vol. III. contains but one paper pertaining to otology, that on "Hearing, Physiology of," by W. G. Thompson.

Vol. IV. contains a paper on "Mastoid Operations," by the editor, an acknowledged authority on the subject; one on "Artificial Membrana Tympani," by C. Hackley; and "Ménières Disease," by W. W. Seeley.

Vol. V. has only one otological paper, that on "Medical Otology," by the editor.

Besides these papers on otology, there are many others, particularly in the domain of general pathology, which the otologist will read with interest and profit. The work is what it claims to be—a reference hand-book of the medical sciences, and contains a great amount of information in a readily accessible form.

S. M. B.

**Lehrbuch der Ohrenheilkunde für praktische Aerzte und Studierende.** Von Prof. Dr. ADAM POLITZER. Zweite gänzlich umgearbeitete Auflage. Mit 285 in den Text gedruckten Abbildungen. Stuttgart: Verlag von Ferdinand Enke. Preis Mk. 14. (Text-Book of Otology for Practitioners and Students. By Prof. Dr. ADAM POLITZER. Second edition, entirely rewritten. With 285 illustrations printed in the text. Price Mark 14—\$3.50.) Reviewed by A. BARTH, Berlin. Translated by M. TOEPLITZ, New York.

The work in its present shape is more comprehensive and more attractive than before. The numerous additions comprise all the advances otology has made since the appearance of the first edition. The number of illustrations is increased from 125 to 285.

I may be permitted to dwell upon some of the details, in which the new edition differs from the former, or from the opinions of other authors. In contradistinction to the former edition we find that perichondritis does not occur so rarely as it was previously generally supposed. The acceptance of LOEWE'S proposition, in the form of a simple note, to remove polypi by means of forced syringing, might not be followed by aurists. The author is, and as I believe correctly, opposed to SCHWARTZE in his plea for the treatment with powdered boric acid in acute and chronic suppuration of the middle ear. He recommends, also, the treatment with alcohol for chronic swelling of the mucous membrane of the middle ear and for small and inaccessible polypi, whilst he would limit the appli-

cation of the so-called caustic method, *i.e.*, the systematic treatment with strong solutions of nitrate of silver. We find on page 441 the sentence: "Combinations of ozæna with diseases of the ear are much rarer than we should suppose from the extension of the process towards the entrance of the Eustach. tube. Where the ear is implicated, the mucous membrane of the middle ear becomes most frequently sclerosed." He permits paracentesis in acute purulent otitis only when a perforation is to be expected from the examination of the drum-head. In simple secretory catarrh of the middle ear, the author is not so reserved in the application of the method. He uses almost exclusively catheters of hard rubber. I deem it necessary to add to the remarks made upon HARTMANN's canula, that this, when used, should not be connected with a simple syringe, but with a rubber ball, provided with a double valve, which sucks the fluid up after each evacuation, without causing any change in the position of the canula. The instrument is applicable only in this form, in which Hartmann has used it for years. As a factor, increasing the subjective sensations of hearing and often simulating peculiar diseases, which is often found in female patients, constipation of the bowels should be inserted at the proper place.

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#### MISCELLANEOUS NEWS.

The Fourth International Otological Congress will be held in Brussels, Belgium, from September 10th to 16th, 1888, immediately after the meeting of the German naturalists and physicians in Cologne, Germany. The names of aurists who will attend and the titles of papers to be read will be received up to May 15, 1888, by the local committee on arrangements:

Dr. CHAS. DELSTANCHE, *President*. Dr. C. GORIS, *Secretary*.



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